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RANGELAND MONITORING

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Utilization Studies

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DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT

RANGELAND MONITORING

UTILIZATION STUDIES

TECHNICAL REFERENCE 4400-3

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RANGELAND MONITORING - UTILIZATION STUDIES

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1. UTILIZATION DATA.

Utilization data are important in evaluating the effects of grazing and browsing on specific areas of rangeland administered by the Bureau of Land Management (BLM) for livestock, wildlife, wild horse, and wild burro use. Utilization is generally expressed as a percentage of available forage weight or numbers of plants, twigs, etc., that have been consumed or destroyed. Utilization is expressed in terms of the current year's production removed. Permittees, lessess, other rangeland users, and interested parties should be consulted and encouraged to participate in the collection and use of utilization data. (See Sections 2.2 through 2.4, Technical Reference 4400-1.)

1.1 Short-term Use of Utilization Data. In the short-term, utilization data are considered with actual use and climate data to determine resource use levels and to identify needed adjustments in management actions. These same data can be used in the short-term as the basis for adjusting grazing use by agreement or grazing decision.

1.2 Long-term Use of Utilization Data. Utilization data are considered along with actual use, authorized use, estimated use, trend, climate, and any other data available or necessary for allotment, wildlife habitat area, herd management area, watershed area, or other designated management area evaluations. Evaluations are conducted to determine if management actions and/or practices are achieving short-term and long-term management objectives identified in the land-use, coordinated resource management, and activity plans.

2. COLLECTING UTILIZATION DATA.

2.1 Frequency of Studies. Utilization studies may be conducted as frequently as needed to satisfy data requirements for allotment, wildlife habitat area, herd management area, watershed area, or other designated management area evaluations. In some cases, utilization studies are started upon initiation of intensive management and continued annually through one complete cycle of a grazing system, or for as long as necessary. It may be necessary to conduct utilization studies annually until management objectives are achieved and maintained. Utilization studies may also be conducted at periodic intervals in sequence with grazing treatments. For example, utilization studies on individual pastures could be conducted once every three years on a three-pasture grazing system and once every five years on a five-pasture grazing system. Where studies are conducted only once during each grazing cycle, they should be conducted at the same point in each cycle so that the data will be comparable.

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2.2 Timing of Studies. Utilization studies are generally conducted at the end of each period of use within pastures or allotments. They may also be conducted at any time during the period of use. Where livestock, wildlife, wild horses, and/or wild burros are present, it may be necessary to conduct utilization studies both before and after discrete periods of use by these animals to estimate the percent utilization by kind of animal. Where regrowth may occur, utilization studies should be conducted as soon as possible following the end of the period of use. (See Section 3.6.) Utilization studies on browse species must be conducted before new twig growth occurs to obtain accurate measurements or observations of past use.

2.3 Documentation. Utilization data are recorded on appropriate forms. Forms for the utilization study methods described in this Technical Reference are included in the Illustrations Section. Close-up and/or general view photographs may be used with any of the utilization study methods. (See Section 3.4, Technical Reference 4400-4.) File the forms, photographs, and any other pertinent information in the allotment file or as otherwise prescribed. (See Section 6, Technical Reference 4400-1.)

3. KEY CONSIDERATIONS.

Consistency is important in measuring or estimating utilization.

3.1 Plant Species Identification. It is important that the plant species be properly identified when conducting utilization studies. In some cases, it may be helpful to include pressed plant specimens, photographs, or other aids used for species identification in the study file. If data are collected prior to positive species identification, examiners should collect plant specimens for later verification.

3.2 Percent Utilization. "Desired," or "target," utilization levels for specific areas of rangeland are reflected in the management objectives of land-use, coordinated resource management, and activity plans. These levels refer to the desired utilization of key plant species or several plant species within a key area. The desired percent utilization for a plant species can vary from plant community to plant community. It can also vary depending on period of use, previous intensity of use, and growth conditions or vigor of the plants. Other demands, such as concurrent or seasonal use by more than one animal species, may also be important in the selection of the desired utilization level. Percent utilization is expressed in terms of plant species and locality.

3.3 Plants Used to Determine Utilization. Generally, only plants of the selected key species are used in utilization studies. This does not preclude sampling plants of other species on the key area if these additional data are needed.

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3.4 Plant Height-Weight Relationship. Weight is not evenly distributed throughout the height or length of plants of any given species. For most rangeland plants, a high percentage of the weight is in the basal portion of the plant or twig where growth is thicker or more dense. A low percentage of plant weight is in the upper portion where growth is tapered or less dense. When estimating percent utilization, adjust for differences in weight by height or length. Weight distribution in relation to height is reasonably constant among individuals of the same plant species.

3.5 Utilization Cages. Utilization cages are used to provide a guide to utilization and production. Grasses, forbs, and shrubs can be protected from foraging with these cages. Utilization cages should not appreciably disrupt normal vegetation growth. The cages must be moved each year at the beginning of the foraging period. This will allow for comparison of rangelands inside and outside the protected plots. These cages can be used to show utilization rates to all interested parties. They can also be used to collect information showing forage production flucutations due to yearly climatic changes. (See Section 5.21e(3) and Appendix.)

3.6 Regrowth. Regrowth is the plant growth that occurs following an interruption of growth by grazing, fire, etc., as well as the plant growth that occurs in response to favorable weather events following the normal growing season. When animals use the same area more than once a year and plant regrowth may occur or has occurred, utilization is still based on the amount of growth available at the time the data are collected. The percent utilization after each period of use represents only the amount of available growth that has been utilized up to the time the studies are conducted. Utilization percentages recorded for various periods of use during a year cannot be added together to get total utilization for the year. In other words, 30 percent utilization of 6 inches of plant growth available in the spring, and 30 percent utilization of 12 inches of plant growth available in the fall, do not add up to 60 percent utilization for the year.

3.7 Transects. Utilization transects are located within representative portions of the key areas. (See Section 5.12, Technical Reference 4400-1.)

3.71 Starting Point. The starting point of a transect is located in relation to a known reference marker.

3.72 Bearing or Direction. The bearing or direction of the transect from the starting point should either be set by compass or directed toward a permanent, clearly-defined, highly visible, natural feature. Straight line transects should cross drainages, if possible, in order to obtain a representative sample of the key area. Where the uplands and drainages have significantly different levels of utilization, they should not be included within the same key area since extremes in percent utilization on one portion of the key area may mask extremes on other portions of the area.

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3.73 Observations and Plots.

a. Sampling Interval. Observations or plots are located at constant intervals along a transect. If the key species or other selected species is not present at the selected interval, relocate the observation or plot point to the nearest individual of that species along the transect line. The next interval along the transect is measured from this relocated point.

b. Observation Sites. Exercise care to ensure that observation sites do not overlap.

c. Plot Size. If plots are used, all plots on a transect must be of the same size so that the individual plot percentages may be added together and averaged.

d. Number of Observations or Plots. A minimum of 25 observations or plots is recommended for collecting utilization data on key areas. Normally, between 25 and 100 observations or plots will give consistent results. Inaccuracies produced by estimating utilization tend to be reduced as a larger number of samples is taken.

e. Marking Locations. The location of the observations or plots along the transect may be recorded on a map or aerial photo.

3.74 Transect Documentation. Record the location, starting point, direction, sampling interval, and other pertinent information concerning a transect on the Study Location and Documentation Data Form. (See Illustration 1, this Reference, and Section 6, Technical Reference 4400-1.) This documentation enables the examiners to conduct follow-up studies in a consistent manner to provide comparable data for analysis, interpretation, and evaluation.

4. UTILIZATION PATTERNS (USE ZONES).

Rangelands include various combinations of range sites and vegetation types on which utilization is seldom uniform. Utilization patterns (use zones) may result from a number of factors which either alone or in combination cause foraging animals to concentrate in specific areas or to spread out over large areas.

4.1 Base for Mapping Utilization Patterns. Aerial photographs, ortho-photo quads, or topographic maps are good bases on which to map utilization patterns. It is important that the selected base show range sites or vegetation types and physical features such as fences, water, and roads. If utilization patterns are mapped on mylar overlays on the base map, the patterns can easily be compared between years.

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4.2 Mapping Utilization Patterns. The first step in conducting utilization studies is the preparation of a map which shows the forage utilization patterns in a pasture, allotment, or other unit. Mapping utilization patterns involves traversing the allotment or pasture to obtain a general concept of these patterns. Features such as topography, rockiness, size of area, location of salt, and distance from water affect foraging habits of the different kinds of animals. These features are helpful in denoting utilization patterns and mapping their boundaries. Permittees, lessees, other rangeland users, and interested parties should be consulted and encouraged to participate in the mapping of utilization patterns. (See Section 2.4, Technical Reference 4400-1.) Unused areas suitable for grazing and areas of animal concentration should be delineated to help identify range improvements needed to change grazing use distribution. Unsuitable areas should also be delineated. Utilization patterns may be mapped for wildlife, wild horses, or wild burros, as well as for livestock following discrete use periods by these animals. Mapped utilization patterns can be used to stratify an allotment or pasture and to select key areas. (See Section 5.11b(6), Technical Reference 4400-1.)

5. UTILIZATION STUDY METHODS.

5.1 Selecting a Method. In the selection of a utilization study method, remember that no one method is suitable for all situations. Carefully consider the advantages and limitations of each method with respect to the area and purpose for which the study will be conducted. Estimation methods permit collection of a greater number of samples than methods that require measuring or clipping and weighing (with the same time and personnel). However, the accuracy of the estimates is dependent on the training and experience of the examiners.

5.2 Methods for Herbaceous Species.

5.21 PAIRED PLOT METHOD. Under the Paired Plot Method, forage from protected and unprotected plots is clipped and weighed at the end of the foraging period. The difference represents the amount of forage consumed by animals or otherwise destroyed during that period.

a. Areas of Use. This method is suitable for all vegetation growth forms for which production and utilization data are commonly desired. It is particularly applicable where periods of use are short, utilization relatively uniform, and regrowth after foraging is not significant.

b. Advantages and Limitations. The method is a simple and direct way of measuring forage utilization. Little training is required and accuracy is generally high. The chief limitations are that it is time-consuming and that a check area, protected from foraging, is required. Also, where periods of use are long, the method does not provide information about the cumulative production of foraged plants unless the cages are moved at short time intervals.

c. Equipment.

(1) Study Location and Documentation Data Form. (See Illustration 1.)

(2) Utilization Study Data - Paired Plot Method Form. (See Illustration 2.)

(3) Frames to delineate plots.

(4) Portable cages to protect plots.

(5) Stakes for anchoring cages.

(6) Hammer for pounding stakes.

(7) Clipping shears.

(8) Paper sacks.

(9) Spring scale, calibrated in grams.

d. Training. The Paired Plot Method does not require intensive training for field application. Examiners must be able to identify plant species. Examiners can perform the actual clipping and weighing after only a short training period. (See Section 3, this Reference, and Section 4, Technical Reference 4400-1.)

e. Establishing Studies. Select key area(s) and key species and determine the number, size, and location of the plots. (See Section 3, this Reference, and Section 5, Technical Reference 4400-1.)

(1) Plot Location. Locate paired plots within key area(s). Mark the location of the plots so they can be relocated. Record the location and documentation of the study on the Study Location and Documentation Data Form. (See Illustration 1, this Reference, and Section 6, Technical Reference 4400-1.)

(a) Plant Composition and Growth. Plant composition and amount of growth must be similar in both plots. Each plot must contain the key species.

(b) Continuing Study. Clipping the plants has a marked influence on their physiological activities and the ecology of the site. Therefore, plots cannot be used again after they are clipped. New plots must be selected for continuing study.

(2) Number of Plots. Establish at least three sets of paired plots (three protected and three unprotected) in each key area selected for study. This is a minimum; establish more if needed.

(3) Protected Plots. Protect one plot of each pair from foraging. Flip a coin to decide which plot to protect.

(a) Cages. Anchor a cage over one of the paired plots at each plot location. See Appendix for examples of several kinds of utilization cages. The base of a cage should be large enough to provide at least a 6-inch buffer zone between the edge of the plot and the side of the cage. The lower portion of the cage (to approximately one to two feet high) may be covered with wire netting small enough to exclude rabbits and rodents. Generally, the larger the mesh, the less influence the cage has in modifying the environment. (See Section 3.5.)

(b) Exclosures. Protected plots may be located in exclosures. These plots need not be caged unless it is necessary to exclude rabbits and rodents.

i. Permanent Exclosures. If protected plots are located within permanent exclosures, caution must be exercised to ensure that these plots are representative of the unforaged situation outside the exclosures.

ii. Temporary Exclosures. Protected plots may be located within temporary exclosures, such as exclosures constructed with electric fence. Plots protected by temporary exclosures can be moved every year to eliminate the artificial environment created by continued non-use in permanent exclosures.

(4) Unprotected Plots. Leave one plot of each pair open to foraging. If past experience shows that foraging is particularly uneven, leave two or more plots open for each one caged in order to average the unevenly foraged conditions. Animals are attracted to cages and may trample unprotected plots if located too near protected plots. Therefore, establish unprotected plots a minimum of 100 feet from protected plots. Unprotected plots should be inconspicuously marked to avoid attracting animals.

f. Sampling Process. After examiners are trained, proceed with the collection of utilization data.

(1) Clip current year's growth on key species from protected and unprotected plots.

(2) On herbaceous species, clip all current year's growth to ground level.

(3) On browse species, remove all current year's growth available for foraging animals. For large browse plants, the available current year's growth may be removed from part of the plant rather than from the whole plant. The proportion of the browse removed is then converted to total weight based on sample size. (Example: If one-fourth of the available current year's growth of browse on a browse plant is removed, the weight of the browse removed times four equals the total weight.)

(4) Put the clippings from the protected and unprotected plots in separate paper sacks for weighing.

(5) Weigh the sacks of clipped plants and record separately the weight from the protected and unprotected plots on the Utilization Study Data - Paired Plot Method Form. (See Illustration 2.) Subtract the weight of the sack before recording the weights of the plants.

g. Calculating Percent Utilization.

(1) Calculate the percent utilization as follows:

$$\% \text{ utilization} = \frac{\text{total protected weight} - \text{total unprotected weight}}{\text{total protected weight}} \times 100$$

(2) If an unequal number of protected and unprotected plots are used in the study, calculate the percent utilization as follows:

$$\% \text{ utilization} = \frac{\text{average weight for protected plots} - \text{average weight for unprotected plots}}{\text{average weight for protected plots}} \times 100$$

(3) Record the percent utilization on the Utilization Study Data - Paired Plot Method Form. (See Illustration 2.)

5.22 OCULAR ESTIMATE METHOD. The Ocular Estimate Method is used to determine utilization along a transect by ocular estimate of the percentage by weight of forage removed from individual plants of the key species or from all plants of the key species on small plots.

a. Areas of Use. This method has wide applicability and is suited for use with grasses and forbs.

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b. Advantages and Limitations. The most important advantage is speed. The method is also reasonably accurate, depending upon the ability of the examiners. Vegetation is not disturbed. Reliability of estimates is increased by limiting observations to individual plants or small areas (plots). Errors in personal judgment on individual plants or plots frequently tend to be compensating. A limitation is that exclosures, cages, or fenced areas may be needed for training.

c. Equipment.

(1) Study Location and Documentation Data Form. (See Illustration 1.)

(2) Utilization Study Data - Ocular Estimate Method Form. (See Illustration 3.)

(3) Frames to delineate plots (if necessary).

(4) Clipping shears.

(5) Paper sacks.

(6) Spring scale, calibrated in grams.

d. Training. The accuracy of utilization percentage estimates is dependent upon thoroughness of training and ability of examiners to identify the plant species and to estimate amount of use. The examiners must first compare their ocular estimates against actual weight values obtained by clipping and weighing. (See Section 3, this Reference, and Section 4, Technical Reference 4400-1.)

(1) Training Sites. Locate sites for training purposes on key areas or on similar unforaged or protected sites. If it is unlikely that a site containing unforaged vegetation will be available after the foraging season, it will be necessary to construct temporary exclosures or install cages on key areas prior to the period of use.

(2) Making Ocular Estimates. Training involves estimating utilization on individual plants of the key species or on all plants of the key species on a small plot. If plots are to be used for the studies, use plots of the same size for training. (See Section 3.73c.) The plots should be small enough so that the entire plot is clearly visible to the examiner. Examiners should practice making ocular estimates as follows:

(a) Clip individual plants of the key species, or plants of the key species on a plot, to simulate foraging (sample A).

(b) Estimate the percentage of weight removed.

(c) Clip the remaining forage of the selected plants by removing all current year's growth available to the foraging animals (sample B).

(d) Put the clippings for samples A and B in separate paper sacks.

(e) Weigh samples A and B separately and subtract sack weight from the weight of each sample.

(f) Calculate the percent simulated use by dividing the weight of sample A by the combined weight of samples A and B and multiplying the value by 100.

(g) Compare estimates with the actual percent forage removed and determine the error of the estimates. Continue training until examiners can recognize the different percentages of use with minimum acceptable error.

(3) Checking Ocular Estimates. Training checks should be made and recorded each day prior to field estimation. This gives a permanent record of the accuracy of each examiner's ocular estimates.

e. Establishing Studies. Select key area(s) and key species and determine the number, length, and location of the transects. (See Section 3, this Reference, and Section 5, Technical Reference 4400-1.) Document the location and other pertinent information concerning a transect on the Study Location and Documentation Data Form. (See Illustration 1, this Reference, and Section 6, Technical Reference 4400-1.)

f. Sampling Process. After examiners are trained and are confident in their ability to recognize various degrees of utilization, proceed with the collection of utilization data.

(1) At each interval along a transect, select the plant of the key species nearest the toe and estimate and record the percent utilization.

(2) If a plot is being used, place the frame immediately in front of the toe or on the nearest site having the key species and estimate and record the percent utilization.

(3) Record the percent utilization on the Utilization Study Data - Ocular Estimate Method Form. (See Illustration 3.)

g. Calculating Percent Utilization. Calculate the average percent utilization by totaling the utilization estimates for the plants or plots along the transect and dividing the total by the number of sampled plants or plots. Record the average utilization on the Utilization Study Data - Ocular Estimate Method Form. (See Illustration 3.)

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5.23 KEY FORAGE PLANT METHOD. The Key Forage Plant Method is an ocular estimate of forage utilization within one of six utilization classes. Observations are made of the appearance of the rangeland and especially the key species, along a transect which traverses the key area.

a. Areas of Use. This method is adapted to areas where perennial grasses, forbs, and/or browse plants are the key species and utilization data must be obtained over large areas using few examiners.

b. Advantages and Limitations. This method is rapid and does not require unused areas for training purposes. Estimates are based on a descriptive term representing a broad range (class) of utilization rather than a precise amount. Different examiners are more likely to estimate utilization in the same classes than to estimate the same utilization percentages.

c. Equipment.

(1) Study Location and Documentation Data Form. (See Illustration 1.)

(2) Utilization Study Data - Key Forage Plant Method Form. (See Illustration 4.)

(3) Tally counter (optional).

d. Training. Personal judgment is involved in any estimation method. Estimates are only as good as the training and experience of the examiners. (See Section 3, this Reference, and Section 4, Technical Reference 4400-1.) The training described for the Ocular Estimate Method often helps examiners using this method make the utilization class estimations. (See Section 5.22d.) This method requires that the examiners be trained to:

(1) Identify the plant species.

(2) Recognize the six herbaceous or six browse utilization classes using the written class descriptions.

(3) Think in terms of the general appearance of the rangeland (slightly used, heavily used, etc.) at each observation point, rather than weight or height removed.

e. Establishing Studies. Select key area(s) and key species and determine the number, length, and location of the transects. (See Section 3, this Reference, and Section 5, Technical Reference 4400-1.) Document the location and other pertinent information concerning a transect on the Study Location and Documentation Data Form. (See Illustration 1, this Reference, and Section 6, Technical Reference 4400-1.)

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f. Sampling Process. After examiners are trained and have confidence in their ability to judge utilization by utilization class ("light", "heavy", etc.), proceed with the collection of utilization data. At each observation point along the transect, estimate the utilization class using the written description of the class. In those cases where part of a class description does not apply (example: percentage of seedstalks remaining), judge utilization based on those parts of the description that do apply. An observation point is the immediate area containing the key species visible to examiners when standing at a particular location along the transect. (See Section 3.73b.) Record the estimates by dot count by utilization class on the Utilization Study Data - Key Forage Plant Method Form. (See Illustration 4.)

(1) Herbaceous Utilization Classes. Six utilization classes are used to show relative degrees of use of key herbaceous species (grasses and forbs). Each class represents a numerical range of percent utilization. Estimate utilization within one of the six classes. Utilization classes are described as follows:

(a) No Use (0-5%). The rangeland shows no evidence of grazing use; or the rangeland has the appearance of negligible grazing.

(b) Slight (6-20%). The rangeland has the appearance of very light grazing. The key herbaceous forage plants may be topped or slightly used. Current seedstalks and young plants of key herbaceous species are little disturbed.

(c) Light (21-40%). The rangeland may be topped, skimmed, or grazed in patches. The low value herbaceous plants are ungrazed and 60 to 80 percent of the number of current seedstalks of key herbaceous plants remain intact. Most young plants are undamaged.

(d) Moderate (41-60%). The rangeland appears entirely covered as uniformly as natural features and facilities will allow. Fifteen to 25 percent of the number of current seedstalks of key herbaceous species remain intact. No more than 10 percent of the number of low value herbaceous forage plants are utilized. (Moderate use does not imply proper use.)

(e) Heavy (61-80%). The rangeland has the appearance of complete search. Key herbaceous species are almost completely utilized with less than 10 percent of the current seedstalks remaining. Shoots of rhizomatous grasses are missing. More than 10 percent of the number of low value herbaceous forage plants have been utilized.

(f) Severe (81-100%). The rangeland has a mown appearance and there are indications of repeated coverage. There is no evidence of reproduction or current seedstalks of key herbaceous species. Key herbaceous forage species are completely utilized. The remaining stubble of preferred grasses is grazed to the soil surface.

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(2) Browse Utilization Classes. Six utilization classes show relative degrees of use of available current year's growth (leaders) of key browse plants (shrubs, half shrubs, woody vines, and trees). Each class represents a numerical range of percent utilization. Estimate utilization within one of the six classes. Utilization classes are described as follows:

(a) No Use (0-5%). Browse plants show no evidence of use; or browse plants have the appearance of negligible use.

(b) Slight (6-20%). Browse plants have the appearance of very light use. The available leaders of key browse plants are litle disturbed.

(c) Light (21-40%). There is obvious evidence of leader use. The available leaders appear cropped or browsed in patches and 60 to 80% of the available leader growth of the key browse plants remains intact.

(d) Moderate (41-60%). Browse plants appear rather uniformly utilized and 40 to 60% of the available leader growth of key browse plants remains intact.

(e) Heavy (61-80%). The use of the browse gives the appearance of complete search. The preferred browse plants are hedged and some plant clumps may be slightly broken. Nearly all available leaders are used and few terminal buds remain on key browse plants. Between 20 to 40% of the available leader growth of the key browse plants remains intact.

(f) Severe (81-100%). There are indications of repeated coverage. There is no evidence of terminal buds and usually less than 20% of available leader growth on the key browse plants remains intact. Some, and often much, of the second and third years' growth of the browse plants has been utilized. Hedging is readily apparent and the browse plants are more frequently broken.

g. Calculating Percent Utilization. Calculate the percent utilization as follows:

(1) Convert the dot count to the number of observations for each utilization class.

(2) Multiply the number of observations in each utilization class times the midpoints of the class intervals.

(3) Total the products for all classes.

(4) Divide the sum by the total number of observations on the transect.

(5) Record the average percent utilization on the Utilization Study Data - Key Forage Plant Method Form. (See Illustration 4.)

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5.24 HEIGHT-WEIGHT METHOD. The Height-Weight Method involves the measurement of heights of ungrazed and grazed grass or grasslike plants to determine average utilization. Measurements of plant heights recorded along transects are converted to percent of weight utilized by means of a utilization gauge (Lommasson and Jensen 1943). The utilization gauge is developed from height-weight relationship curves. This method provides a mechanical tool which can be used for training, checking personal judgment, and promoting uniformity of results between examiners as well as for determining percent utilization.

a. Areas of Use. This method is adapted for obtaining utilization data where the key species are either bunch or rhizomatous/sod-forming grasses or grasslike species.

b. Advantages and Limitations. This method provides for uniform, accurate, and reliable utilization determinations for perennial grasses and grasslike species. It is an objective method; however, some estimation is required. Accurate utilization scales may not be available for the key species. The development of the height-weight relationship curves and preparation of utilization gauge scales can be time-consuming. This method is not used for determining utilization of forbs and shrubs.

c. Equipment.

(1) Study Location and Documentation Data Form. (See Illustration 1.)

(2) Utilization Study Data - Height-Weight Method Form. (See Illustration 5.)

(3) Utilization gauge. (See Illustration 6.)

(4) Utilization scales for key species. (See Illustration 6, pages 2 and 3.)

(5) Tape measure or ruler.

(6) Additional equipment needed to prepare utilization scales:

(a) Clipping shears

(b) Thread

(c) Paper trimmer (for clipping plants into segments)

(d) Paper sacks

(e) Scale calibrated in tenths of grams

(f) Graph paper

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(g) Blank card for utilization gauge.

d. Training. This method does not require intensive training for field application. Examiners must be able to identify the plant species. Examiners measure and record the height of grazed and ungrazed plants, determine the utilization of individual plants from the gauge, and calculate the average utilization by key species. (See Section 3, this Reference, and Section 4, Technical Reference 4400-1.)

e. Establishing Studies. Select key area(s) and key species and determine the number, length, and location of the transects. (See Section 3, this Reference, and Section 5, Technical Reference 4400-1.) Document the location and other pertinent information concerning a transect on the Study Location and Documentation Data Form. (See Illustration 1, this Reference, and Section 6, Technical Reference 4400-1.)

f. Sampling Process. Sample ungrazed and grazed plants encountered along a transect to determine the average ungrazed plant height and the average percent utilization. To secure reliable utilization determinations, it is essential to measure heights for an adequate number of ungrazed and grazed plants. The greater the variation in utilization between plants, the more plants required to determine the average utilization.

(1) Measuring Plant Heights.

(a) Best results are obtained by placing the measuring tape or ruler in the center of the bunch or turf circle, rather than along one side. The tape or ruler should not be forced down into the crown but should rest firmly on the cushioned portion of the plant.

(b) Where rhizomatous/sod-forming grasses or grasslike plants are the key species, use a circle of turf two inches in diameter as one plant.

(2) Sampling Plants

(a) At each interval along the transect, select the plant of the key species (seedlings excepted) nearest the toe and measure the height of the plant to the nearest 1/4 inch. If plants are not evenly grazed, determine the average stubble height.

(b) If the selected plant has not been grazed, record the height for that sample in the Ungrazed Height Column on Utilization Study Data - Height-Weight Method Form. (See Illustration 5.)

(c) If the selected plant has been grazed, record the height for that sample in the Grazed Height Column on the Utilization Study Data - Height-Weight Method Form. (See Illustration 5.)

(d) Measure at least twenty ungrazed plants to obtain a reliable cross section of ungrazed plant heights. If a sufficient number of ungrazed plants is not encountered along the transect on the key area, it may be necessary to extend the transect to pick up the additional ungrazed plant heights. In some cases it may be necessary to select, in a subjective manner, ungrazed plants on an adjacent area to determine average ungrazed plant height.

(e) Use only one kind of plant. When 80 percent or more of the plants measured produce culms or when 80 percent or more are without culms, the remaining 20 percent or less may be disregarded without great error.

(f) When a combination occurs with 80 percent or more culm-producing plants, and a plant lacking culms is encountered nearest the sampling point, measure the nearest culm-producing plant of the species. Corresponding procedure should be followed when the kind of plant selected is without culms and a culm-producing plant is encountered. These two combinations are those most commonly encountered in the field.

(g) When approximately equal numbers of culm and culmless plants occur, measure plants of both kinds. The measurements for the plants with culms should be marked or kept separate on the form. Due precautions are necessary to use appropriate ungrazed heights and the correct utilization scales for plants with and without culms.

g. Calculating Percent Utilization. Calculate the percent utilization as follows:

(1) Divide the total of the ungrazed plant heights by the number of ungrazed plants sampled to calculate the average ungrazed plant height.

(2) Calculate the percent utilization of individual sampled plants of the key species with the gauge by using the "Average Ungrazed Height" and the height of the sampled plant. The sliding card in the gauge is pulled out of the envelope until the utilization scale for the key species appears in the window. The dial is then turned so that the number representing the previously calculated average ungrazed height is set at the arrow designated "Average Ungrazed Height". The percent utilization may then be read on the scale in the window opposite the number on the dial representing the measured stubble-height of the sampled plant. The utilization scale on the sliding card must fit the species being sampled. (See Section 5.24h.) Use the culmless curve for the key species when utilization studies are conducted on early growth of the plants.

(3) Calculate the average utilization for a key species by totaling the percent utilization for the individual sampled plants and dividing by the number of sampled plants of that species.

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(4) Record the average height of ungrazed plants, percent utilization of individual sampled plants, and averge percent utilization for the key species on the Utilization Study Data - Height-Weight Method Form. (See Illustration 5.)

h. Preparing Utilization Scales. Utilization scales used with the utilization gauge are prepared from height-weight curves developed for individual grass and grasslike species. Previously prepared utilization scales must be checked to see whether or not these scales fit the species on the rangeland where they will be used. (See Illustration 6, pages 2 and 3.) Where existing utilization scales do not fit, new scales will have to be prepared. Scales for a number of species are included on the same card.

(1) Developing Height-Weight Curves. Develop height-weight curves by collecting plants of a given species and determining the height-weight relationship for that species. The curve for any given species must be checked for variation between range sites and climatic regions. It is necessary to develop separate curves for culm-producing plants and culmless plants when a species only sporadically produces culms.

(a) Sampling Plants. Sample at least ten plants of a given species. Select only those plants which have reached maximum growth.

i. At each interval along a pace transect, choose the ungrazed plant of the given species nearest the toe. Use one square inch as a unit area for sod-forming species and a comparable number of stems as a unit area for single stem species.

ii. Remove all old leaves and stems of previous year's growth.

iii. Clip the plant to within 1/4 inch of the ground.

iv. Wrap the clipped plant with thread from base to top to retain all leaves and culms in their natural position.

v. Separate the plants with culms from plants without culms and consider each as a separate sample.

vi. Measure heights of clipped plants to the nearest inch and determine the average height.

vii. Calculate the number of plants that must be sampled to determine mean height with a standard error of $\pm$ 3 to 5 percent at the 95 percent confidence level (Barrett and Nutt 1979, Freese 1962).

viii. Sample additional plants, if necessary.

ix. Measure the maximum height of each plant.

x. Clip the top 10 percent by height of each plant and place the clippings in a paper sack labeled 0 to 10 percent. Clip additional height segments in 10 percent increments and place clippings in appropriately labeled sacks--11 to 20 percent, 21 to 30 percent, 31 to 40 percent, 41 to 50 percent, 51 to 60 percent, 61 to 70 percent, 71 to 80 percent, 81 to 90 percent, and 91 to 100 percent. A large paper trimmer with a guide to hold the plants in their proper position on the platform may be used to clip plants into segments. Label the sacks to show species, date, and location. Place a given height segment for all plants of a species collected in one paper sack.

xi. Dry the clippings until a constant weight, to the nearest tenth of a gram, is achieved. Leave clippings in the paper sacks for drying.

(b) Determining Height-Weight Relationships.

i. Weigh and record the weights for each of the ten height segments to the nearest tenth of a gram. Subtract sack weight before recording the dry weights of each height segment. (See Illustration 7.)

ii. Total the dry weights of the ten height segments and record the total dry weight of the collected plants. (See Illustration 7.)

iii. Record the cumulative weight for each segment. This includes the weight of the segment plus the weights of all preceding segments starting from the top of the plant. (See Illustration 7.)

iv. Calculate the cumulative percent weight removed at each height segment by dividing the cumulative weight for each segment by the total weight and multiplying by 100. (See Illustration 7.)

v. Plot the cumulative percent height removed against the cumulative percent weight removed on graph paper. The resulting curve portrays the height removed-weight removed relationship for the species. (See Illustrations 7 and 8.)

(2) Transferring Data from Curves to Scales. Transfer the height-weight relationship data portrayed on the height-weight curve to a utilization scale for use in the utilization gauge.

(a) Turn the dial on the utilization gauge so that 10 inches is set at the arrow designated "Average Ungrazed Height." With the dial set at 10, each inch increment from 9 to 0 on the dial represents 10 percent of the height. (See Illustration 9.)

(b) Slide a blank card into the utilization gauge.

(c) Use the height-weight curve to determine the percent height that would be removed when 10 percent, 15 percent, through 95 to 98 percent of the weight is removed. (See Illustrations 8 and 9.)

(d) Enter 10 percent, 15 percent through 95 to 98 percent weight removed on the scale in the window of the utilization gauge across from the point on the dial representing the corresponding percent height removed. With the dial set at 10 inches for "Average Ungrazed Height," the percent removed can easily be converted to inches removed. (See Illustration 9.)

(3) Documenting Scale Preparation. For each utilization scale prepared, maintain a record of the species, the data used to prepare the scale, the date the scale was prepared, and the areas of applicability.

5.25 ACTUAL WEIGHT METHOD. The Actual Weight Method involves the separate clipping and weighing of grazed and ungrazed plants along a transect. The difference between weights represents the amount of forage consumed by animals or otherwise destroyed during the period of use.

a. Areas of Use. The method is best adapted to clearly defined growth forms such as bunchgrasses. It is not recommended for areas where shrubs or rhizomatous plants are the key species. It can be used on sod-forming grasses if a small plot, 2 or 3 inches square, is used to delineate a unit.

b. Advantages and Limitations. The method is simple and accurate. It is restricted in use primarily to bunch and sod-forming grasses.

c. Equipment.

(1) Study Location and Documentation Data Form. (See Illustration 1.)

(2) Utilization Study Data - Actual Weight Method Form. (See Illustration 10.)

(3) Frames to delineate plots (if necessary).

(4) Clipping shears.

(5) Paper sacks.

(6) Spring scale, calibrated in grams.

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d. Training. Little training is required for this method. Examiners must be able to identify the plant species. Training is limited to clipping and weighing grazed and ungrazed plants and recording the weights. (See Section 3, this Reference, and Section 4, Technical Reference 4400-1.)

e. Establishing Studies. Select key area(s) and key species and determine the number, length, and location of the transects. (See Section 3, this Reference, and Section 5, Technical Reference 4400-1.) Document the location and other pertinent information concerning a transect on the Study Location and Documentation Data Form. (See Illustration 1, this Reference, and Section 6, Technical Reference 4400-1.)

f. Sampling Process. After examiners are trained, proceed with the collection of utilization data.

(1) Select two paper sacks for each key species; one is marked "grazed" and the other "ungrazed."

(2) At each interval along the transect, clip the plant of the key species nearest the toe to ground level. Collection of grazed and ungrazed plants as they occur along the transect is extremely important. Only the plants collected along the transect are used in calculating utilization.

(3) Place the plant, grazed or ungrazed, in the respective sack and mark a tally on the outside of the sack or on a tally sheet. For example, a grazed plant is clipped and placed in the sack marked "grazed". The tally is made so the number of plants in each sack is known.

(4) Clip plants along the transect until there are at least 25 plants (or some other predetermined number) in each of the grazed and ungrazed sacks. Do not discontinue clipping one kind (grazed or ungrazed) of plant when extending the transect to satisfy the minimum quota for the other kind of plant. The grazed and ungrazed sacks may not contain the same number of plants. (For example, if the grazed sack contains 25 plants and the ungrazed sack contains 20 plants, continue to clip grazed and ungrazed plants encountered along the transect until the ungrazed sack contains 25 plants. In this example the grazed sack will probably contain more than 25 plants when the minimum quota of ungrazed plants is met.)

(5) Determine the number of grazed and ungrazed plants that were clipped.

(6) Weigh each sack separately to determine the weights of the grazed and ungrazed plants.

(7) Record the numbers and weights on the Utilization Study Data - Actual Weight Method Form. (See Illustration 10.)

(8) If sufficient ungrazed plants cannot be found on the key area, clip ungrazed plants along a transect in an adjoining area, in an ungrazed pasture within the allotment, or in another ungrazed area in the vicinity to obtain the average weight of ungrazed plants. These sites must be as similar as possible (vegetation type, soil, etc.) to the area in which the study is being conducted.

g. Calculating Percent Utilization. Calculate the percent utilization as follows:

(1) Step 1. Calculate the average weight of ungrazed plants.

$$\frac{\text{Total weight of ungrazed plants}}{\text{Total number of ungrazed plants}} = \text{Average weight of ungrazed plants}$$

(2) Step 2. Calculate the total weight of all clipped plants as if none had been grazed.

$$\text{Total number of plants clipped (both grazed and ungrazed)} \times \text{Average weight of ungrazed plants} = \text{Total weight of all clipped plants as if none had been grazed}$$

(3) Step 3. Calculate the percent of total production (weight) remaining.

$$\frac{\text{Total weight of clipped plants (grazed and ungrazed)}}{\text{Total weight of all clipped plants as if none had been grazed}} \times 100 = \text{Percent of total production (weight) remaining}$$

(4) Step 4. Calculate the percent utilized.

$$100\% - \text{Percent of total production (weight) remaining} = \text{Percent Utilized}$$

(5) Step 5. Record the percent utilization on the Utilization Study Data - Actual Weight Method Form. (See Illustration 10.)

5.26 STEM COUNT METHOD. The Stem Count Method involves counting grazed and ungrazed stems in plots along a transect. It is based on the theory that percent utilization is directly related to the total number of stems grazed.

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a. Areas of Use. This method was developed for use on mixed grass prairie rangelands. It is recommended for rangelands where western wheatgrass (Agropyron smithii) or other single-stem rhizomatous grasses are the important forage species. If the key species is not present at the proper interval at least 50 percent of the time, a different method for determining utilization should be used.

b. Advantages and Limitations. The method is simple and comparatively free from personal or procedural error. Some problem may arise in determining what is a single plant when more than one stem appears from a rhizome. Count stems--not plants.

c. Equipment.

(1) Study Location and Documentation Data Form. (See Illustration 1.)

(2) Utilization Study Data - Stem Count Method Form. (See Illustration 11.)

(3) Frame to delineate plots (a one-square-foot plot is suggested).

d. Training. Little training is required for this method. Examiners must be able to identify the plant species. Examiners count and record the number of grazed and ungrazed stems of the grasses on the plots. (See Section 3, this Reference, and Section 4, Technical Reference 4400-1.)

e. Establishing Studies. Select key area(s) and key species and determine the number, length, and location of the transects. (See Section 3, this Reference, and Section 5, Technical Reference 4400-1.) Document the location and other pertinent information concerning a transect on the Study Location and Documentation Data Form. (See Illustration 1, this Reference, and Section 6, Technical Reference 4400-1.)

f. Sampling Process. After examiners are trained, proceed with the collection of utilization data.

(1) At each interval along the transect, place the frame immediately in front of the toe or on the nearest site having the key species.

(2) Count all grazed and ungrazed stems of the key species in each plot and record the numbers separately on the Utilization Study Data - Stem Count Method Form. (See Illustration 11.)

g. Calculating Percent Utilization. Calculate the percent utilization (percent of stems grazed) by dividing the total number of grazed stems by the total number of stems (grazed plus ungrazed) and multiplying the result by 100. Record the percent utilization on the Utilization Study Data - Stem Count Method Form. (See Illustration 11.)

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5.27 GRAZED-CLASS METHOD. The Grazed-Class Method uses photo guides of key species to make utilization estimates along a transect. These estimates reflect herbage removed but also show herbage remaining.

a. Areas of Use. This method is adapted for use on perennial grass, perennial grass-forb, and grass-shrub rangelands where the key species are either bunch or rhizomatous/sod-forming grass or grasslike species. It is designed for use after the plants have made full seasonal growth.

b. Advantages and Limitations.

(1) This method is rapid and easy to learn and use. It can be used by livestock operators and examiners to give consistent and accurate estimates of utilization. Errors in judgment are compensating and the mathematics involved are simple. In poor growth years when plants do not mature, the guides will not distinguish between use and no-growth.

(2) The difficult job is the development of photo guides based on average plants on a typical site that have a good photo-height-weight fit. One guide, properly developed for a given species and a typical site, can be used on all sites over a fairly broad area (e.g., the south-west) in good and bad production years without serious error. The guides serve as standards of comparison which promote consistency in estimates and facilitate estimation of irregular use of plants.

c. Equipment.

(1) Study Location and Documentation Data Form. (See Illustration 1.)

(2) Utilization Study Data - Grazed-Class Method Form. (See Illustration 12.)

(3) Photo guides. (See Illustration 13.)

(4) Tally counter (optional).

(5) Additional equipment needed to develop photo guides.

(a) Clipping shears.

(b) Paper sacks.

(c) Scale calibrated in tenths of grams.

(d) Graph paper.

d. Training. Minimal training of examiners is needed to use this method. Examiners must be able to identify the plant species. The major problem with inexperienced examiners, and examiners who have not used the method for some time, is underestimation of use on heavier grazed plants. (See Section 3, this Reference, and Section 4, Technical Reference 4400-1.)

e. Establishing Studies. Select key area(s) and key species and determine the number, length, and location of the transects. (See Section 3, this Reference, and Section 5, Technical Reference 4400-1.) Document the location and other pertinent information concerning a transect on the Study Location and Documentation Data Form. (See Illustration 1, this Reference, and Section 6, Technical Reference 4400-1.)

f. Sampling Process. After examiners are trained, proceed with the collection of utilization data.

(1) At each interval along the transect, select the plant(s) of the key species (seedlings excepted) nearest the toe.

(2) Compare the sample plant(s) with the photo guides for that species and classify according to one of six grazed-classes representing 0, 10, 30, 50, 70, or 90 percent use. (See Illustration 13.)

(3) Base the estimates of utilization on growth form of the plant. Variations in height growth due to site characteristics and seasonal precipitation can be disregarded since variations in height are automatically adjusted for by the eye.

(4) Record the estimates by dot count for each grazed class on the Utilization Study Data - Grazed-Class Method Form. (See Illustration 12.)

(5) For bunchy key species, make estimates on individual plants.

(6) For rhizomatous/sod-forming key species, make estimates on 6-, 8-, 10-, or 12-inch square plots along the transect.

g. Calculating Percent Utilization. Calculate the percent utilization as follows:

(1) Convert the dot count to the number of plants sampled by grazed-class.

(2) Multiply the number of plants sampled in each grazed-class times the grazed-class percent.

(3) Total the products for all classes.

(4) Divide the sum by the total number of samples on the transect.

(5) Record the average percent utilization on the Utilization Study Data - Grazed-Class Method Form. (See Illustration 12.)

h. Developing Photo Guides. Photo guides must be developed that have a close fit between the grazed-class percentages of the guide and the height-weight curve of the plant photographed. Guides are developed as follows:

(1) When plants of a given species have reached full growth, sample 5 to 10 representative plants from a typical site. For bunchy species, sample individual plants. For rhizomatous/sod-forming species, sample plants from a 6-, 8-, 10-, or 12-inch square plot.

(2) Beginning at the top of the plant, clip 4- to 10-inch segments from the top portion and 2-inch segments from the lower portion of each plant. Place each segment in an individual paper sack. Label the sacks to show species, plant number, segment number, segment length, date, and location. Keep the clippings from each plant separate. Make all height measurements from the base of the plant. (See Illustration 14.)

(3) Oven dry and carefully weigh each plant segment to the nearest tenth of a gram. Subtract sack weight before recording the dry weight of each segment. (See Illustration 14.)

(4) Beginning at the top of the plant, record the cumulative dry weight for each segment. This includes the weight of the segment plus the weights of all preceding segments. (See Illustration 14.)

(5) Calculate the cumulative percent weight for each segment by dividing the cumulative dry weight for each segment by the total dry weight and multiplying the result by 100. (See Illustration 14.)

(6) Beginning at the base of each plant, record the cumulative height remaining by segment. This includes the combined length of all preceding segments. (See Illustration 14.)

(7) Determine the average height of the clipped plants.

(8) Adjust the height remaining of each individual plant to average plant-height remaining with the following formula:

$$\text{Adjusted individual plant-height remaining} = \frac{\text{Total height of average plant}}{\text{Total height of individual plant}} \times \text{Height remaining of individual plant}$$

(9) Plot the cumulative percent weight of the individual plants against the adjusted individual plant-height remaining on graph paper. (See Illustration 15.) Use the lower left hand corner as zero on both scales and plot 5 or 6 clipped plants of a given species on the same graph.

(10) Determine the average plant height for the six grazed-class percentages (percent weight removed), 0, 10, 30, 50, 70 and 90 percent, from the height-weight curves on the graph. (See Illustration 15.)

(11) Return to the field and select 4 to 6 average plants to be used in making a photo guide for the given species. Use the grazed-class heights read from the average curve on the graph to determine the heights at which to clip the plants to be photographed using the formula:

$$\text{Clipping height of plant to be photographed} = \frac{\text{Total height of plant to be photographed}}{\text{Total height of average plant}} \times \text{Grazed-class height of average plant}$$

(12) Photograph each plant in sequence at the unclipped height and at heights representing 10, 30, 50, 70 and 90 percent weight removed. Clip the last increment to ground level.

(13) Sack the clippings separately and dry them in an oven. Label the sacks to show species, plant number, clipped height, grazed-class percentage, date and location.

(14) Determine if the curve of at least one of the photographed plants closely matches the average curve on the graph. In addition, determine if the cumulative weight percentages for the various clipped heights of that plant closely match the grazed-class percentages (within 2 or 3 percentage points). If a close match is obtained, trim the photos and photograph on a grazed-class photo guide background. (See Illustration 13.) If not, repeat the photographing of average plants until a close fit is obtained.

(15) For each photo guide prepared, maintain a record of the species, the data used to prepare the guide, the date the guide was prepared, and the areas of applicability.

5.3 Methods for Browse Species. In addition to the methods described in this section, the Paired Plot and Key Forage Plant Methods described in Sections 5.21 and 5.23, respectively, can also be used for browse species.

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5.31 TWIG LENGTH MEASUREMENT METHOD. Under the Twig Length Measurement Method, utilization is determined by measuring twigs on 25 to 50 browse plants after full annual growth has occurred and again after the period of use. The difference between the two measurements is the amount of browse that has been utilized. Separate transects are run for different browse species.

a. Areas of Use. This method of determining utilization is restricted to use on browse species which clearly exhibit annual twig growth, such as bitterbrush and mountain mahogany.

b. Advantages and Limitations.

(1) Percent utilization determined by measurement is more accurate than when determined by estimation. This method is useful in determining the amount of use made on browse plants by livestock and the amount of use made on the same browse plants by wildlife, wild horses, and/or wild burros. The degree of direct forage competition among different kinds of animals can be determined where there are discrete periods of use by the different animals. Growth and use indexes can also be determined.

(2) Good utilization estimates can be obtained with this method even though twig volume is not uniformly distributed along the length of twigs. The results will vary with species due to twig growth characteristics. The method is not reliable on species which do not clearly exhibit annual twig growth, such as sagebrush and serviceberry. It is also not reliable in areas of the southwest where annual twig growth may be masked by almost continuous growth or erratic seasonal growth after rains.

(3) Time and expense needed for gathering data are doubled because the measurements must be made twice a year.

c. Equipment.

(1) Study Location and Documentation Data Form. (See Illustration 1.)

(2) Utilization Study Data - Twig Length Measurement Method Form. (See Illustration 16.)

(3) Twenty-five to 50 numbered metal tags.

(4) Roll of soft copper or aluminum wire.

(5) Six-inch and 12-inch rulers.

(6) Compass.

(7) Steel post.

(8) Post driver.

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d. Training. This method does not require intensive training for field application. Examiners must be able to identify the plant species and recognize annual twig growth on the selected key species. (See Section 3, this Reference, and Section 4, Technical Reference 4400-1.)

e. Establishing Studies. Select key area(s) and key species and determine the number, length, and location of the transects. (See Section 3, this Reference, and Section 5, Technical Reference 4400-1.)

(1) In mixed stands of key browse, such as bitterbrush and mountain mahogany, establish separate transects for each species.

(2) Permanently locate transects by means of a reference post placed near the beginning of the transect. An alternative is to select a reference point, such as a prominent natural feature, and give the bearing and distance to the beginning of the transect. If a post is used, it should be tagged to indicate that it marks the location of a monitoring study established by the Bureau of Land Management.

(3) At the beginning of each transect, determine the transect bearing and select a prominent distant landmark such as a large tree, rocky point, etc., that can be used as the transect bearing point.

(4) Plot the transects on detailed allotment maps and/or aerial photos.

(5) Document the location and other pertinent information concerning a transect on the Study Location and Documentation Data Form. (See Illustration 1, this Reference, and Section 6, Technical Reference 4400-1.)

f. Sampling Process. After examiners are trained and are confident in their ability to recognize annual twig growth on the key species, proceed with the collection of utilization data.

(1) Tag plants of only one species per transect.

(2) Tag 25 to 50 plants of the selected key species on each transect.

(3) Objectively tag plants along the transect. The first tagged plant is ten paces from the beginning point of the transect along the transect bearing. The distance between tagged plants, thereafter, should be at least five paces.

(4) At the end of each pacing interval, select and tag the closest plant of the key species within a 180 degree zone ahead of the examiner. (See Illustration 18 for a schematic of the 180 degree selection zone.)

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(5) Attach a numbered metal tag to an individual branch of the selected browse plant with soft copper or aluminum wire. The wire should be loosely attached on the branch to allow for future growth. There should be a minimum of 10 twigs with new growth between the point of the tag and the end of the branch. Only one tag per plant is needed.

(6) Measure the length of current growth (to the nearest 1/2 inch or nearest centimeter) on all twigs from the point of tag attachment to the end of the branch. Record the data on the Utilization Study Data - Twig Length Measurement Method Form. (See Illustration 16.)

(a) Make the first measurements after plants of the selected key species have attained full annual growth.

(b) Make subsequent measurements after the period of use.

(7) Where use of tagged plants occurs prior to completion of full annual growth, estimate the use and enter the percentage by plant on the Utilization Study Data - Twig Length Measurement Method Form. (See Illustration 16.)

(8) Face the transect bearing point and begin the next pacing interval from the last tagged plant.

g. Calculations. Calculations can be made on the back of the Utilization Study Data - Twig Length Measurement Method Form. (See Illustration 16.)

(1) Average Estimated Use Prior to Completion of Full Annual Growth. Determine the average estimated use made prior to completion of full annual growth by totaling the estimated percent utilization for the individual plants and dividing the total by the number of tagged plants.

(2) Percent Utilization. Calculate the percent utilization as follows:

(a) Total the twig measurements made after completion of full annual growth for each tagged plant.

(b) Total the twig measurements made after the period of use for each tagged plant.

(c) Calculate percent utilization of individual tagged plants as follows:

$$\frac{\text{Total twig length by plant after full annual growth} - \text{Total twig length by plant after period of use}}{\text{Total twig length by plant after full annual growth}} \times 100 = \text{Percent utilization}$$

(d) Calculate the average percent utilization for the key species on the transect by totaling the percent utilization for the individual tagged plants and dividing the total by the number of tagged plants. The average percent utilization may also be calculated as follows:

$$\frac{\text{Total twig length for all tagged plants after full annual growth} - \text{Total twig length for all plants after period of use}}{\text{Total twig length for all tagged plants after full annual growth}} \times 100 = \text{Average percent utilization}$$

(e) Determine the total percent utilization by adding the average estimated use prior to completion of full annual growth and the average percent utilization for the period(s) of use.

(3) Growth Index.

(a) The growth index is the average twig length for all tagged plants as determined from the measurements obtained after completion of full annual growth. This index can be used to compare the amounts of growth which occur in different years and as an indication of species vigor.

(b) Calculate the growth index as follows:

$$\frac{\text{Total twig length for all tagged plants after full annual growth}}{\text{No. of twigs measured}} = \text{Growth index (Average twig length)}$$

(c) If use occurred on the plants prior to measurement after completion of full annual growth, adjust the growth index to account for this use as follows:

$$\frac{\text{Growth index (Average twig length)}}{100\% - \text{Average estimated use prior to completion of full annual growth}} \times 100 = \text{Adjusted growth index}$$

(4) Use Index.

(a) The use index is an indication of the volume of browse removed. This index can be used to compare the amounts of browse removed in different years.

(b) Calculate the use index by multiplying the total percent utilization times the adjusted growth index and dividing by 100. For example, if total utilization is 50 percent and the adjusted growth index is 6 inches, the use index is 3. If total utilization is 50 percent and the adjusted growth index is 3 inches, the use index is 1.5. Although utilization is the same in both examples, twice as much browse was removed in the first example.

RANGELAND MONITORING - UTILIZATION STUDIES

5.32 COLE BROWSE METHOD. Under the Cole Browse Method, a transect is run to collect data on 25 to 50 plants of a browse species. This method provides data on age and form classes, availability and hedging, estimated utilization, and growth and use indexes for the browse component of the plant community. These data are used to make annual utilization and trend estimates. Separate transects are run for different browse species.

a. Areas of Use. This method can be used in a wide variety of vegetation types where browse key species clearly exhibit annual leader growth.

b. Advantages and Limitations. The Cole Browse Method is more rapid than methods that require measurements; however, it is somewhat less accurate because estimates rather than measurements are used to determine utilization. There can be considerable variation in utilization estimates as well as in age and form class estimates among examiners. Plant growth characteristics, weather conditions, and site conditions may have an equal or greater influence on the appearance of plants than leader use. In addition, age class and form class may not always be sensitive indicators of the effects of browsing.

c. Equipment.

(1) Study Location and Documentation Data Form. (See Illustration 1.)

(2) Utilization Study Data - Cole Browse Method Form. (See Illustration 17.)

(3) Compass.

(4) Ten-foot tape.

(5) Steel posts.

(6) Post driver.

(7) Six-inch and 12-inch rulers.

d. Training. The accuracy of utilization percentage estimates is dependent upon thoroughness of training and ability of examiners to identify plant species and to estimate amount of use. Examiners must be able to recognize annual leader growth on key species, availability of browse for use by animals, the three degrees of hedging, and the age classes of browse plants. (See Section 3, this Reference, and Section 4, Technical Reference 4400-1.)

e. Establishing Studies. Select key area(s) and key species and determine the number, length, and location of the transects. (See Section 3, this Reference, and Section 5, Technical Reference 4400-1.)

RANGELAND MONITORING - UTILIZATION STUDIES

(1) Establish permanent transects for sampling the selected key species. Sample only one species on each transect.

(2) Select the plant of the key species which will be the first plant sampled and from which the transect will begin.

(3) Stand at the edge of the selected browse plant and face the direction the transect will run. Select a prominent distant landmark such as a large tree, rocky point, etc., that can be used as the transect bearing point.

(4) Drive steel posts at intervals of 5 and 10 feet behind the selected browse plant, such that the posts, the selected browse plant, and the transect bearing point are all in line. (See Illustration 18.)

(5) Tag the post located farthest (10 feet) from the selected browse plant to indicate that it marks the location of a monitoring study established by the Bureau of Land Management.

(6) Plot the transects on detailed allotment maps and/or aerial photos.

(7) Document the location and other pertinent information concerning a transect on the Study Location and Documentation Data Form. (See Illustration 1, this Reference and Section 6, Technical Reference 4400-1.)

(8) Temporary transects may be used for locating key areas or for gathering data on browse stands outside key areas. These transects are not marked on the ground.

f. Sampling Process. After examiners are trained and are confident in their ability to recognize annual leader growth, availability of browse, degree of utilization, degree of hedging, and age class of browse plants, proceed with the collection of data.

(1) Collecting Data. Beginning with the first selected plant, make the necessary observations, estimates, and measurements and record the data on the Utilization Study Data - Cole Browse Method Form. (See Illustration 17.)

(a) Form Class. Observe the selected plant and check the appropriate Form Class Column on the form.

RANGELAND MONITORING - UTILIZATION STUDIES

i. The form classes are as follows:

No.	Form Class
1	All available, little or no hedging
2	All available, moderately hedged
3	All available, severely hedged
4	Partially available, little or no hedging
5	Partially available, moderately hedged
6	Partially available, severely hedged
7	Unavailable
8	Dead

ii. Availability refers to browse available to the animals.

iii. The three degrees of hedging are based on the length and appearance of two-year-old wood (previous year's leaders) immediately below the current leaders. (See Illustration 19.) If more than one degree of hedging is evident on a plant, form class is based on the predominant or average condition. The three degrees of hedging are:

Little or no hedging - Two-year-old wood is relatively long and unaltered or only slightly altered.

Moderately hedged - Two-year-old wood is fairly long but most of it has been altered from the normal growth form.

Severely hedged - Two-year-old wood is relatively short and/or strongly altered from the normal growth form.

iv. Browse plants are considered to reflect the normal growth form when less than 50 percent of the two-year-old growth (the previous year's leaders) has clipped ends and a majority of the current leaders extend directly from terminal buds off two-year-old wood. Alterations from the normal growth form are reflected when 50 percent or more of the two-year-old wood has clipped ends. Current leaders occur mostly as extensions from lateral buds off two-year-old wood in the moderately hedged condition or as clumped lateral and/or adventitious sprouts in the severely hedged condition.

v. The length of two-year-old wood reflects the relative vigor of the previous year's leader growth and/or the effects of prior use. Since the degrees of hedging are confined to two-year-old wood, they reflect the effects of use during a previous year, or a succession of previous years.

vi. The three degrees of hedging provide a measure of the relative condition of browse plants and assess short-term effects of different intensities of leader use.

(b) Age Class. Age class data reflect the establishment, survival, and decadence of key browse plants. Observe the selected plant and check the appropriate Age Class Column on the form. An age class assignment is not made for sample plants in form classes 7 and 8. The four age classes are:

S - Seedling - New plants that have survived at least one growing season, but are not more than two or three years old. The basal stems are generally 1/8 inch or less in diameter.

Y - Young - Young plants usually less than 10 years old. Elongated growth form and simple branching with basal stems no greater than approximately 1/2 inch in diameter.

M - Mature - Plants more than 10 years old. Distinguished by heavier, often gnarled stems, and complex branching. Canopy made up of more than 50 percent living wood. Basal stems are often greater than 1/2 inch in diameter.

D - Decadent - Browse plants with more than 50 percent of the canopy area dead.

(c) Leader Use Estimates. Leader use is an estimate of the intensity of use on browse plants available to the animals. Estimate the percent of available leaders that have been browsed on each sample plant. This estimate is based on the number of leaders that have been browsed and not on the percent of growth removed. Leader use estimates are not made for sample plants in form classes 7 and 8. Determine the use class that the estimate falls in and enter the class value in the Leader Use Column on the form. For example, if estimated leader use is 15 percent, then the recorded value will be 25 percent; if estimated use is 80 percent, the recorded value will be 75 percent. The leader use class percentage ranges and the corresponding class values are:

Leader Use Class Percentage Range	Class Values (%)
0	0
1-10	5
11-40	25
41-60	50
61-90	75
91-100	95

(d) Leader Length Measurements. Measure current growth on the ungrazed leaders on the available portion of each sampled plant on the transect. These measurements are taken to determine the average annual growth or growth index. Record these measurements (to the nearest 1/2 inch or nearest centimeter) on the back of the form.

(2) Selecting the Nearest Plant. Stand at the edge of the sampled plant and face toward the transect bearing point. Select and sample the nearest plant of the key species that occurs within a 180 degree zone. (See Illustration 18.) Repeat this routine until 25 to 50 plants have been sampled.

(3) Modifying the Transect for Dense Browse Stands. The transect should be long enough to cross the key area being sampled. In dense browse stands, the distance traveled on a 25- to 50-plant transect will be very short. To lengthen a transect, stand at the edge of the plant at the beginning of the transect and pace off some desired distance (5 paces, 20 paces, etc.) in the direction of the transect bearing point. At the end of the pacing interval, select the nearest plant in the 180 degree zone. Use the same pacing interval throughout the transect.

g. Calculations. Make the calculations and record the results in the appropriate column or blank on the Utilization Study Data - Cole Browse Method Form. (See Illustration 17.)

(1) Form Class Summary. Total the number of plants in each form class and enter the value in the Total Column on the form. Calculate the percent composition by form class as follows:

$$\frac{\text{Total no. of plants in a form class}}{\text{Total no. of plants sampled}} \times 100 = \text{Percent composition by form class}$$

Enter the value in the Percent Column on the form.

(2) Age Class Summary. Total the number of plants in each age class and enter the value in the Total Column on the form. Calculate percent composition by age class as follows:

$$\frac{\text{Total no. of plants in age class}}{\text{Total no. of plants sampled}} \times 100 = \text{Percent composition by age class}$$

Enter the value in the Percent Column on the form.

(3) Average Leader Use. Calculate the average leader use as follows:

$$\frac{\text{Total estimated leader use for all plants}}{\text{Total no. of plants sampled}} = \text{Average leader use (\%)}$$

Record the value on the form.

(4) Average Leader Length or Growth Index.

(a) The growth index is the average length of the ungrazed leaders on the sampled plants. This index can be used to compare the amounts of growth which occur in different years and as an indication of species vigor.

(b) Calculate the average leader length or growth index as follows:

$$\frac{\text{Total length of ungrazed leaders}}{\text{Total no. of leaders measured}} = \text{Average length of ungrazed leaders or growth index}$$

Record the value on the form.

(5) Use Index.

(a) The use index is an indication of the volume of browse removed. This index can be used to compare amounts of browse removed in different years.

(b) Calculate the use index by multiplying the average leader use (%) times the average leader length (growth index) and dividing by 100. Record the use index on the form. For example, if average leader use is 50 percent and the average leader length is 6 inches, the use index is 3. If average leader use is 50 percent and the average leader length is 3 inches, the use index is 1.5. Although utilization is the same in both examples, twice as much browse was removed in the first example.

5.33 EXTENSIVE BROWSE METHOD. Under the Extensive Browse Method, a 100-point pace transect is run to collect vegetation data. This method provides data on utilization, species composition, age classes, form classes, availability, and hedging for the browse component of the plant community.

a. Areas of Use. This method can be used within a wide variety of vegetation types.

b. Advantages and Limitations. The Extensive Browse Method is rapid and can be used on all browse species. It is well adapted to situations where browse data must be obtained from large areas with limited personnel. All browse species within the plant community can be sampled on one transect. The method is more rapid than methods which require measurements. However, it is somewhat less accurate than measurement methods in determining utilization because estimates rather than measurements are used. This method is designed to eliminate personal bias and keep consistency at a maximum.

c. Equipment.

(1) Study Location and Documentation Data Form. (See Illustration 1.)

(2) Utilization Study Data - Extensive Browse Method Form. (See Illustration 20.)

(3) Tally counter (optional).

d. Training. The accuracy of utilization percentage estimates is dependent on thoroughness of training and ability of examiners to identify the plant species and to estimate amount of use. Examiners must be able to recognize the availability of browse for use by animals, the three degrees of hedging, and the age classes of browse plants. (See Section 3, this Reference, and Section 4, Technical Reference 4400-1.)

e. Establishing Studies. Select key area(s) and key species and determine the number, length, and location of the transects. (See Section 3, this Reference, and Section 5, Technical Reference 4400-1.)

(1) Locate the "heaviest used" or "representative" areas in an allotment. The intent is to find several areas used intensively during the period of use. These may occur in the same general location each year, but will probably fluctuate. Transects are located in heavy use areas since vegetation changes which occur as a result of browsing will be evident first on these areas.

(2) Place the transects in the areas selected for that year. Do not establish permanent transects because the area(s) selected for sampling may change from year to year.

(3) Select a transect starting point and a transect bearing point, such as a prominent natural feature, to help maintain the intended line of travel.

(4) Although transects are not permanent, plot them on detailed allotment maps and/or aerial photos for documentation and future reference.

(5) Record the documentation under "Notes" on the Utilization Study Data - Extensive Browse Method Form, or on the Study Location and Documentation Data Form. (See Illustrations 1 and 20.)

f. Sampling Process. After examiners are trained and are confident in their ability to recognize availability of browse, degree of utilization, degree of hedging, and age classes of browse plants, proceed with the collection of data.

(1) Selecting the Sample Plants.

(a) At the end of each pacing interval, face toward the transect bearing point, select and sample the nearest browse plant that occurs within a 180 degree zone. (See Illustration 18 for a schematic of the 180 degree selection zone.)

(b) Begin each pacing interval from the last sampled plant. Pace toward the transect bearing point in the interspaces between browse plants. It is not necessary to pace in an absolutely straight line.

(2) Collecting Data. Make observations and estimates on the selected browse plant, and record the data by species on the Utilization Study Data - Extensive Browse Method Form. (See Illustration 20.) Use a dot count or tally counter to keep track of the number of plants sampled.

(a) Utilization. Select a branch on the sample browse plant and estimate the amount of utilization of current annual growth.

i. Select a branch at random. For example,

(i) Note the second hand location or the digital seconds readout on a watch.

(ii) Using the route of travel along the transect line as the 6 o'clock - 12 o'clock line, go to the position on the browse plant that is indicated by the location of the second hand or the digital second readout. (Example - 20 seconds represents the 4 o'clock position.)

(iii) Select an available branch on that side of the plant.

ii. Count down ten leaders of annual growth and determine the number of these leaders which show any evidence of use. Convert this number to percent (i.e., two leaders used equals 20 percent use; six leaders used equals 60 percent use, etc.). Record the value by dot tally in the appropriate column on the form.

iii. After sampling the plant at the 50th point, figure the average utilization for each species encountered on the first half of the transect. Circle the plant code for all species averaging $\geq$ 50 percent use at this point. (See Section 5.33g(1).)

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iv. Sample points 51-100 as follows:

(i) If the selected plant is one of the circled species, record the data in the same manner as for the first 50 plants.

(ii) If the selected plant is not one of the circled species, record the data as previously described. In addition, locate the nearest plant of any of the circled species and record its utilization (only) in the appropriate column opposite the species plant code. Do not record age class and form class for these additional plants.

(b) Age Class. Age class data reflect the establishment, survival, and decadence of key browse plants. Observe the selected plant and record (by dot tally) the age class by species in the appropriate column on the form. The four age classes are as follows:

S - Seedling - New plants that have survived at least one growing season, but are not more than two or three years old. The basal stems are generally 1/8 inch or less in diameter.

Y - Young - Young plants usually less than 10 years old. Elongated growth form and simple branching with basal stems no greater than approximately 1/2 inch in diameter.

M - Mature - Plants more than 10 years old. Distinguished by heavier, often gnarled stems, and complex branching. Canopy made up of more than 50 percent living wood. Basal stems are often greater than 1/2 inch in diameter.

D - Decadent - Browse plants with more than 50 percent of the canopy area dead.

(c) Form Class. Observe the selected plant and record (by dot tally) the form class by species in the appropriate column on the form.

i. The form classes are as follows:

No.	Form Class
1	All available, little or no hedging
2	All available, moderately hedged
3	All available, severely hedged
4	Partially available, little or no hedging
5	Partially available, moderately hedged
6	Partially available, severely hedged
7	Unavailable
8	Dead

ii. Availability refers to browse available to the animals.

iii. The three degrees of hedging are based on the length and appearance of two-year-old wood (previous year's leaders) immediately below the current leaders. (See Illustration 19.) If more than one degree of hedging is evident on a plant, form class is based on the predominant or average conditon. The three degrees of hedging are:

Little or no hedging	-	Two-year-old wood is relatively long and unaltered or only slightly altered.
Moderately hedged	-	Two-year-old wood is fairly long but most of it has been altered from the normal growth form.
Severely hedged	-	Two-year-old wood is relatively short and/or strongly altered from the normal growth form.

iv. Browse plants are considered to reflect the normal growth form when less than 50 percent of the two-year-old growth (the previous year's leaders) has clipped ends and a majority of the current leaders extend directly from terminal buds off two-year-old wood. Alterations from the normal growth form are reflected when 50 percent or more of the two-year-old wood has clipped ends. Current leaders occur mostly as extensions from lateral buds off two-year-old wood in the moderately hedged condition or as clumped lateral and/or adventitious sprouts in the severely hedged condition.

v. The length of two-year-old wood reflects the relative vigor of the previous year's leader growth and/or the effects of prior use. Since the degrees of hedging are confined to two-year-old wood, they reflect the effects of use during a previous year, or a succession of previous years.

vi. The three degrees of hedging provide a measure of the relative condition of browse plants and assess short-term effects of different intensities of leader use.

g. Calculations. Make the calculations and record the results in the appropriate columns on the Utilization Study Data - Extensive Browse Method Form. (See Illustration 20.)

(1) Average Utilization by Species.

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(a) For each species, multiply the number of browse plants tallied in each percentage block by the percent indicated in the column heading (0, 10, 20, 30, etc.). Add the figures from each block and enter the total in the Total Percent Utilized Column on the form.

(b) Add the dot tallies for each browse species to determine the total number of plants sampled of that species and enter the total in the Number of Plants Column on the form.

(c) Calculate the average percent utilization for each species by dividing the total percent utilized by the total number of plants. Enter the value in the Average Percent Utilization Column on the form.

(2) Age Class Summary. Add the dot tallies for each age class and enter the totals in the Total Number of Plants Row on the form. Because the age class is determined for 100 plants on the transect, these totals represent the percent composition by age class for the browse portion of the plant community.

(3) Form Class Summary. Add the dot tallies for each form class and enter the totals in the Total Number of Plants Row on the form. Because the form class is determined for 100 plants on the transect, these totals represent the percent composition by form class for the browse portion of the plant community.

(4) Percent Composition by Species. Add the form class dot tallies for each browse species and enter the total in the Number of Plants Column on the form. Because the form class is determined for 100 plants on the transect, these totals represent the species composition percentages for the browse portion of the plant community.

GLOSSARY OF TERMS

-A-

actual use: a report of the actual livestock grazing use certified to be accurate by the permittee or lessee. Actual use may be expressed in terms of animal unit months or animal months. (See 43 CFR 4100.0-5.)

allotment: an area of land designated and managed for grazing of livestock. Such an area may include intermingled private, State, or Federal lands used for grazing in conjunction with the public lands. (See 43 CFR 4100.0-5.)

allotment management plan (AMP): a documented program which applies to livestock grazing on the public lands, prepared in consultation, cooperation, and coordination with the permittee(s), lessee(s), or other involved affected interests. (See 43 CFR 4100.0-5.)

analysis: (1) a detailed examination of anything complex in order to understand its nature or determine its essential features; or (2) a separating or breaking up of any whole into its component parts for the purpose of examining their nature, function, relationship, etc. (A rangeland analysis includes an examination of both biotic (plants, animals, etc.) and abiotic (soils, topography, etc.) attributes of the rangeland.)

animal month: a month's tenure upon the rangeland by one animal. Animal month is not synonymous with animal unit month.

animal unit month (AUM): the amount of forage necessary for the sustenance of one cow or its equivalent for a period of one month. (See 43 CFR 4100.0-5.)

available forage: that portion of the forage production that is accessible for use by a specified kind or class of grazing animal.

-B-

browse: (1) the part of shrubs, half shrubs, woody vines, and trees available for animal consumption; or (2) to search for or consume browse.

browse plant or browse species: a shrub, half shrub, woody vine, or tree capable of producing shoot, twig, and leaf growth suitable for animal consumption.

-C-

canopy cover: the percentage of ground covered by a vertical projection downward of the outermost perimeter of the natural spread of foliage of plants. Small openings within the canopy are included. Canopy cover is synonymous with crown cover.

class of livestock: the age and/or sex groups of a kind of livestock.

community: an assemblage of populations of plants and/or animals in a common spatial arrangement.

composition: the proportions (percentages) of various plant species in relation to the total on a given area. It may be expressed in terms of cover, density, weight, etc.

crown cover: (See canopy cover.)

-D-

density: numbers of individuals or stems per unit area. (Density does not equate to any kind of cover measurement.)

-E-

ecological site: (See range site.)

ecological status: the present state of vegetation of a range site in relation to the potential natural community for the site. Ecological status is use independent. It is an expression of the relative degree to which the kinds, proportions, and amounts of plants in a community resemble that of the potential natural community. The four ecological status classes correspond to 0-25, 26-50, 51-75, or 76-100 percent similarity to the potential natural community and are called early seral, mid seral, late seral, and potential natural community, respectively.

estimated use: the use made of forage on an area by wildlife, wild horses, wild burros, and/or livestock where actual use data are not available. Estimated use may be expressed in terms of animal unit months or animal months.

evaluation: (1) an examination and judgment concerning the worth, quality, significance, amount, degree, or condition of something; or (2) the systematic process for determining the effectiveness of on-the-ground management actions and assessing progress toward meeting management objectives.

-F-

forage: (1) browse and herbage which is available and may provide food for animals or be harvested for feeding; or (2) to search for or consume forage.

forage production: the weight of forage that is produced within a designated period of time or a given area. Production may be expressed as green, air dry, or oven dry weight. The term may also be modified as to time of production such as annual, current year, or seasonal forage production.

forb: (1) any herbaceous plant other than those in the Gramineae (true grasses), Cyperaceae (sedges), and Juncaceae (rushes) families--i.e., any nongrass-like plant having little or no woody material on it; or (2) a broadleaved flowering plant whose stem, above ground, does not become woody and persistent.

forestland: land on which the vegetation is dominated by trees. Lands are classified forestland if the trees now present will provide 25 percent or greater canopy cover at maturity. Lands not presently forestland that were originally or could become forested through natural succession may be classified as potential natural forestland.

frequency: a quantitative expression of the presence or absence of individuals of a species in a population. It is defined as the percentage of occurrrence of a species in a series of samples of uniform size.

-G-

goal: the desired state or condition that a resource management policy or program is designed to achieve. A goal is usually not quantifiable and may not have a specific date by which it is to be completed. Goals are the base from which objectives are developed. (See objective.)

grass: any plant of the family Gramineae.

grassland: land on which the vegetation is dominated by grasses, grasslike plants, and/or forbs. Non-forested lands are classified as grassland if herbaceous vegetation provides at least 80 percent of the canopy cover excluding trees. Lands not presently grassland that were originally or could become grassland through natural succession may be classified as potential natural grassland.

grasslike plant: a plant of the Cyperaceae or Juncaceae families which vegetatively resembles a true grass of the Gramineae family.

grazing management: the manipulation of grazing and browsing animals to accomplish a desired result.

-H-

half shrub: a plant with a woody base whose annually produced stems die each year.

hedging: (1) the appearance of browse plants that have been browsed so as to appear artificially clipped; or (2) consistent browsing of terminal buds of browse species causing excessive lateral branching and a reduction in upward and outward growth.

herbage: the above-ground material of any herbaceous plant (grasses and forbs).

-I-

interpretation: explaining or telling the meaning of something and presenting it in understandable terms.

inventory: the systematic acquisition and analysis of information needed to describe, characterize, or quantify resources for land-use planning and management of the public lands.

-K-

key area: a relatively small portion of a rangeland selected because of its location, use, or grazing value as an area on which to monitor the effects of grazing use. It is assumed that key areas, if properly selected, will reflect the effects of current grazing management over all or a part of a pasture, allotment, or other grazing unit.

key species: (1) those species which must, because of their importance, be considered in a management program; or (2) forage species whose use serves as an indicator to the degree of use of associated species.

kind of livestock: species of domestic livestock--cattle, sheep, horses, burros, and goats.

-M-

monitoring: the orderly collection, analysis, and interpretation of resource data to evaluate progress toward meeting management objectives.

-O-

objective: planned results to be achieved within a stated time period. Objectives are subordinate to goals, are narrower and shorter in range, and have increased possibility of attainment. Time periods for completion and outputs or achievements that are measurable and quantifiable are specified. (See goal.)

-P-

pasture: grazing area enclosed and separated from other areas by fence or natural barrier.

physiognomy: external aspect; characteristic or peculiar contour.

plant association: a kind of potential natural community consisting of stands with essentially the same dominant species in corresponding layers.

potential natural community (PNC): the biotic community that would become established if all successional sequences were completed without interferences by man under the present environmental conditions. Natural disturbances are inherent in development. Includes naturalized non-native species.

proper use: (1) a degree of utilization of current year's growth which, if continued, will achieve management objectives and maintain or improve the long-term productivity of the site; or (2) the percentage a plant is utilized when the rangeland as a whole is properly utilized. Proper use varies with time and systems of grazing. Proper use is synonymous with proper utilization.

proper utilization: (See proper use.)

public lands: any land and interest in land outside of Alaska owned by the United States and administered by the Secretary of the Interior through the Bureau of Land Management. (See 43 CFR 4100.0-5.)

-R-

rangeland: a kind of land which supports vegetation useful for grazing on which routine management of that vegetation is through manipulation of grazing rather than cultural practices. (Rangelands include natural grasslands, savannas, shrublands, most deserts, tundra, alpine communities, coastal marshes, riparian zones, and wet meadows. Rangeland includes lands revegetated naturally or artificially to provide a plant cover which is managed like native vegetation.)

range site: a kind of rangeland with a specific potential natural community and specific physical site characteristics, differing from other kinds of rangeland in its ability to produce vegetation and to respond to management. Range sites are defined and described with soil, species composition, and production emphasis. Range site is synonymous with ecological site.

resource value rating (RVR): the value of vegetation present on a range site for a particular use or benefit. Resource value ratings may be established for each plant community capable of being produced on a range site, including exotic or cultivated species. On a given range site, each use (or potential use) has a separate resource value rating because that rating is based on classification of plants according to their value for a specific use. Some examples: A resource value rating for forage useful for cows and calves during the spring grazing season could be based on proper use factors (PUF's) or a more general assigning of plant species to good, moderate, or poor categories of forage value. Resource value ratings could then be based on production, cover, density, or frequency of plants in the different categories. A resource value rating for cover useful for a pronghorn fawning area might be based on density or cover of plants of a certain height or size class, without regard to plant species. A resource value rating related to scenic beauty might be based on abundance of flowering species, species with fall color, evergreens, diversity of growth forms, etc.

riparian zone: the banks and adjacent areas of water bodies, water courses, seeps, and springs whose waters provide soil moisture sufficiently in excess of that otherwise available locally so as to provide a more moist habitat than that of contiguous flood plains and uplands.

-S-

savanna: a grassland with scattered trees, whether as individuals or clumps; often a transitional type between true grassland and forest.

seral community: one of a series of biotic communities that follow one another in time on any given area. Seral community is synonymous with seral stage, successional community, and successional stage.

seral stage: (See seral community.)

shrub: a plant that has persistent, woody stems and a relatively low growth habit, and that generally produces several basal shoots instead of a single bole. It differs from a tree by its low stature--less than 5 meters (16 feet)--and nonarborescent form.

shrubland: land on which the vegetation is dominated by shrubs. Non-forested lands are classified as shrubland if shrubs provide more than 20 percent of the canopy cover excluding trees. Lands not presently shrubland that were originally or could become shrubland through natural succession may be classified as potential natural shrubland.

stratification: subdividing an area into units which are, more or less, internally homogeneous with respect to the (those) characteristic(s) of interest.

succession: the orderly process of community change; it is the sequence of communities which replace one another in a given area.

successional community: (See seral community.)

successional stage: (See seral community.)

-T-

tree: a woody perennial, usually single-stemmed plant that has a definite crown shape and characteristically reaches a mature height of at least 5 meters (16 feet). Some plants, such as oaks (Quercus spp.), may grow as either trees or shrubs.

trend: the direction of change in ecological status or in resource value ratings observed over time. Trend in ecological status is described as "toward" or "away from" the potential natural community or as "not apparent." Appropriate terms are used to describe trend in resource value ratings. Trend in resource value ratings for several uses on the same site at a given time may be in different directions and there is no necessary correlation between trends in resource value ratings and trend in ecological status.

-U-

unsuitable rangeland: rangeland which has no potential value for, or which should not be used for, a specific use because of permanent physical or biological restrictions. When unsuitable rangeland is identified, the identification must specify what use or uses are unsuitable (e.g., "unsuitable for cattle grazing").

use: (See utilization.)

useable forage: that portion of the forage that can be grazed without damage to the basic resources; may vary with season of use, species, and associated species.

utilization: the proportion or degree of current year's forage production that is consumed or destroyed by animals (including insects). May refer either to a single plant species, a group of species, or to the vegetation as a whole. Utilization is synonymous with use.

-V-

vegetation: plants in general, or the sum total of the plant life above and below ground in an area.

vegetation type: a kind of existing plant community with distinguishable characteristics described in terms of the present vegetation that dominates the aspect or physiognomy of the area.

-W-

wet meadow: a meadow where the surface remains wet or moist throughout the summer, usually characterized by sedges and rushes.

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STUDY LOCATION & DOCUMENTATION DATA

STUDY METHOD		STUDY NUMBER
ALLOTMENT NAME & NUMBER		PASTURE
DISTRICT	RESOURCE AREA	PLANNING UNIT
RANGE SITE		PLANT COMMUNITY
DATE ESTABLISHED	ESTABLISHED BY (NAME)	MAP REFERENCE
ELEVATION	SLOPE / EXPOSURE	AERIAL PHOTO REFERENCE

LOCATION: TOWNSHIP ____ RANGE ____ SECTION ____ 1/4 ____ 1/4 ____ 1/4

SCALE: ____ INCHES EQUALS ONE MILE

KEY SPECIES

1	2	3

DISTANCE & BEARING BETWEEN REFERENCE POST OR REFERENCE POINT AND THE TRANSECT LOCATION STAKE, BEGINNING OF TRANSECT, OR PLOT

DISTANCE & BEARING BETWEEN LOCATION STAKE & BEARING STAKE

TRANSECT BEARING	VERTICAL DISTANCE BETWEEN GROUND & ALIGNED TAPE
LENGTH OF TRANSECT	PLOT/FRAME SIZE
SAMPLING INTERVAL	TOTAL NUMBER OF SAMPLES

NOTES (DESCRIPTION OF STUDY LOCATION, DIAGRAM OF TRANSECT/PLOT LAYOUT, DESCRIPTION OF PHOTO POINTS, ETC. IF MORE SPACE IS NEEDED, USE REVERSE SIDE OR ANOTHER PAGE.)

Illustration 1
Page 2

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STUDY LOCATION & DOCUMENTATION DATA

STUDY METHOD: OCULAR ESTIMATE UTILIZATION	STUDY NUMBER: 035-27W-08-04
ALLOTMENT NAME & NUMBER: QUAKING ASPEN - 1037	PASTURE: SHEEP CREEK
DISTRICT: HOWE	RESOURCE AREA: LOST MOUNTAIN
PLANNING UNIT: DEEP CANYON	
RANGE SITE: CLAYEY - 15-19" NORTHERN PLAINS	PLANT COMMUNITY: ARTR2 - AGSP - PONE
DATE ESTABLISHED: 7/15/84	ESTABLISHED BY (NAME): CHARLIE WAGON
MAP REFERENCE: GRAYSTONE 7½ MIN. TOPO.	
ELEVATION: 4300	SLOPE:
EXPOSURE: EAST	AERIAL PHOTO REFERENCE: BLM-24CN-A277A - 4/22/78

LOCATION	TOWNSHIP	RANGE	SECTION	1/4	1/4	1/4
	35	27W	8	NE	SW	NW

SCALE: 2 INCHES EQUALS ONE MILE

KEY SPECIES

1	2	3
AGSP		

X			

DISTANCE & BEARING BETWEEN REFERENCE POST OR REFERENCE POINT AND THE TRANSECT LOCATION STAKE, BEGINNING OF TRANSECT, OR PLOT
the beginning of the transect is 100 feet north of the reference post - there is no permanent location stake.

DISTANCE & BEARING BETWEEN LOCATION STAKE & BEARING STAKE

TRANSECT BEARING: 25° - toward highest point on skyline

VERTICAL DISTANCE BETWEEN GROUND & ALIGNED TAPE:

LENGTH OF TRANSECT:

PLOT/FRAME SIZE: No frame

SAMPLING INTERVAL: Every 2 paces

TOTAL NUMBER OF SAMPLES: 50

NOTES (DESCRIPTION OF STUDY LOCATION, DIAGRAM OF TRANSECT/PLOT LAYOUT, DESCRIPTION OF PHOTO POINTS, ETC. IF MORE SPACE IS NEEDED, USE REVERSE SIDE OR ANOTHER PAGE.)

This study is located approximately 1 mile north of the Antelope Draw spring development.

Note: Depending on the study method, fill in the blocks that apply when a study is established. This documentation enables the examiners to conduct follow-up studies in a consistent manner to provide comparable data for analysis, interpretation, and evaluation.

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UTILIZATION STUDY DATA
PAIRED PLOT METHOD

STUDY NUMBER	DATE	EXAMINER

ALLOTMENT NAME & NUMBER	PASTURE

KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE

KEY SPECIES	PLOT	WEIGHT IN GRAMS BY PLOT 1	2	3	4	5	TOTAL WEIGHT ***	WEIGHT DIFFERENCE (P-U)	PERCENT UTILIZED $\left(\frac{P-U}{P} \times 100\right)$
1	P*								
	U**								
2	P								
	U								
3	P								
	U								
4	P								
	U								

LOCATION OF PAIRED PLOT 1

LOCATION OF PAIRED PLOT 2

LOCATION OF PAIRED PLOT 3

LOCATION OF PAIRED PLOT 4

LOCATION OF PAIRED PLOT 5

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

*PROTECTED PLOTS **UNPROTECTED PLOTS ***MINUS WEIGHT OF THE SACK

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UTILIZATION STUDY DATA
PAIRED PLOT METHOD

STUDY NUMBER: 155 - 38E - 12 - 02
DATE: 8/15/84
EXAMINER: SAM CRABTREE
ALLOTMENT NAME & NUMBER: LAVA CREEK - 2287
PASTURE:
KIND AND/OR CLASS OF ANIMAL: SHEEP - EWES & LAMBS
PERIOD OF USE: 6/1 to 8/15

KEY SPECIES	PLOT	WEIGHT IN GRAMS BY PLOT 1	2	3	4	5	TOTAL WEIGHT ***	WEIGHT DIFFERENCE (P-U)	PERCENT UTILIZED $\left(\frac{P-U}{P} \times 100\right)$
1 AGSP	P*	25	40	38	30	28	161	76	47%
	U**	15	25	15	18	12	85		
2 PONE3	P	30	28	19	43	25	145	80	55%
	U	16	13	8	17	11	65		
3	P								
	U								
4	P								
	U								

LOCATION OF PAIRED PLOT 1: Caged plot is .5 mile south of road junction in Section 32 - then 300 feet west of road. Uncaged plot is 700 feet SW of caged plot - compass bearing 220° - marked with reinforcing rod.

LOCATION OF PAIRED PLOT 2: Caged plot is 1500 feet north of caged plot 1 - compass bearing 350°. Uncaged plot is 150 feet west of caged plot - compass bearing 265° - marked with reinforcing rod.

LOCATION OF PAIRED PLOT 3: Caged plot is .7 mile west of Springcreek Reservoir. Uncaged plot is 75 paces north of caged plot - marked with reinforcing rod.

LOCATION OF PAIRED PLOT 4: Caged plot is 500 paces south of caged plot 3. Uncaged plot is 50 paces east of caged plot - marked with reinforcing rod.

LOCATION OF PAIRED PLOT 5: Caged plot is .3 mile north of Buckbrush Cattleguard - then 700 feet east of road. Uncaged plot is 200 feet north of caged plot - compass bearing 15° - marked with reinforcing rod.

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

*PROTECTED PLOTS **UNPROTECTED PLOTS ***MINUS WEIGHT OF THE SACK

Illustration 3
Page 1

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UTILIZATION STUDY DATA
OCULAR ESTIMATE METHOD

STUDY NUMBER	DATE	EXAMINER

ALLOTMENT NAME & NUMBER	PASTURE

KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE

OCULAR ESTIMATES BY PLANT (OR PLOT)

KEY SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL

TOTAL ÷ NO. OF SAMPLES (PLANTS OR PLOTS) = AVG. PERCENT UTILIZATION ÷ =

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

OCULAR ESTIMATES BY PLANT (OR PLOT)

KEY SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL

TOTAL ÷ NO. OF SAMPLES (PLANTS OR PLOTS) = AVG. PERCENT UTILIZATION ÷ =

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

Illustration 3
Page 2

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UTILIZATION STUDY DATA
OCULAR ESTIMATE METHOD

STUDY NUMBER	DATE	EXAMINER
035-27W-08-04	7/15/84	CHARLIE WAGON

ALLOTMENT NAME & NUMBER	PASTURE
QUAKING ASPEN - 1037	SHEEP CREEK

KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE
CATTLE - Cows & CALVES	5/16 to 7/15

OCULAR ESTIMATES BY PLANT (OR PLOT)

KEY SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
AGSP	60	35	40	50	70	25	30	40	65	80	50	75	70	40	30	760
	55	40	60	70	65	50	40	60	75	40	30	55	55	60	70	825
	85	75	80	65	50	45	50	70	65	60	40	50	60	65	45	905
	65	50	70	40	35											260

TOTAL ÷ NO. OF SAMPLES (PLANTS OR PLOTS) = AVG. PERCENT UTILIZATION 2750 ÷ 50 = 55%

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

There is no evidence of recent or active erosion. Numerous seedlings of the key species are present. The livestock were in very good condition as they were moved from the allotment. The permittee, Joe Rancher, helped collect the data.

OCULAR ESTIMATES BY PLANT (OR PLOT)

KEY SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL

TOTAL ÷ NO. OF SAMPLES (PLANTS OR PLOTS) = AVG. PERCENT UTILIZATION ÷ =

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

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UTILIZATION STUDY DATA
KEY FORAGE PLANT METHOD

STUDY NUMBER	DATE	EXAMINER

ALLOTMENT NAME & NUMBER	PASTURE

KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE

CLASS INTERVAL	INT MID (M)	KEY SPECIES DOT COUNT	NO BY CLASS (C)	NO X MIDPT (C)(M)	KEY SPECIES DOT COUNT	NO BY CLASS (C)	NO X MIDPT (C)(M)
NO USE 0-5%	2.5						
SLIGHT 6-20%	13						
LIGHT 21-40%	30						
MODERATE 41-60%	50						
HEAVY 61-80%	70						
SEVERE 81-100%	90						
		TOTALS			TOTALS		
AVG. UTIL.	$= \frac{\Sigma(CM)}{\Sigma C}$		=			=	

Herbaceous Utilization Classes. (Browse utilization classes are on the other side.)

1. No use (0-5%). The rangeland shows no evidence of grazing use; or the rangeland has the appearance of negligible grazing.

2. Slight (6-20%). The rangeland has the appearance of very light grazing. The key herbaceous forage plants may be topped or slightly used. Current seedstalks and young plants of key herbaceous species are little disturbed.

3. Light (21-40%). The rangeland may be topped, skimmed, or grazed in patches. The low value herbaceous plants are ungrazed and 60 to 80 percent of the number of current seedstalks of key herbaceous plants remain intact. Most young plants are undamaged.

4. Moderate (41-60%). The rangeland appears entirely covered as uniformly as natural features and facilities will allow. Fifteen to 25 percent of the number of current seedstalks of key herbaceous species remain intact. No more than 10 percent of the number of low value herbaceous forage plants are utilized. (Moderate use does not imply proper use.)

5. Heavy (61-80%). The rangeland has the appearance of complete search. Key herbaceous species are almost completely utilized with less than 10 percent of the current seedstalks remaining. Shoots of rhizomatous grasses are missing. More than 10 percent of the number of low value herbaceous forage plants have been utilized.

6. Severe (81-100%). The rangeland has a mown appearance and there are indications of repeated coverage. There is no evidence of reproduction or current seedstalks of key herbaceous species. Key herbaceous forage species are completely utilized. The remaining stubble of preferred grasses is grazed to the soil surface.

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

*WHERE C = THE NUMBER OF OBSERVATIONS WITHIN EACH CLASS INTERVAL (C COLUMN), M = THE CLASS INTERVAL MIDPOINT (M COLUMN), AND Σ = THE SUMMATION SYMBOL.

Browse Utilization Classes

1. No use (0-5%). Browse plants show no evidence of use; or browse plants have the appearance of negligible use.

2. Slight (6-20%). Browse plants have the appearance of very light use. The available leaders of key browse plants are little disturbed.

3. Light (21-40%). There is obvious evidence of leader use. The available leaders appear cropped or browsed in patches and 60 to 80% of the available leader growth of the key browse plants remains intact.

4. Moderate (41-60%). Browse plants appear rather uniformly utilized and 40 to 60% of the available leader growth of key browse plants remains intact.

5. Heavy (61-80%). The use of the browse gives the appearance of complete search. The preferred browse plants are hedged and some plant clumps may be slightly broken. Nearly all available leaders are used and few terminal buds remain on key browse plants. Between 20 to 40% of the available leader growth of the key browse plants remains intact.

6. Severe (81-100%). There are indications of repeated coverage. There is no evidence of terminal buds and usually less than 20% of available leader growth on the key browse plants remains intact. Some, and often much, of the second and third years' growth of the browse plants has been utilized. Hedging is readily apparent and the browse plants are more frequently broken.

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UTILIZATION STUDY DATA
KEY FORAGE PLANT METHOD

STUDY NUMBER	DATE	EXAMINER
MOONCREEK #1	6/30/84	BUCK CHUGWATER

ALLOTMENT NAME & NUMBER	PASTURE
MOONCREEK - 0817	

KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE
CATTLE - COWS & CALVES	5/1 to 7/30

CLASS INTERVAL	INT MID (M)	KEY SPECIES: BOCU — DOT COUNT	NO BY CLASS (C)	NO X MIDPT (C)(M)	KEY SPECIES — DOT COUNT	NO BY CLASS (C)	NO X MIDPT (C)(M)
NO USE 0-5%	2.5	Γ.	6	15			
SLIGHT 6-20%	13	::	4	52			
LIGHT 21-40%	30	⊠ Γ.	16	480			
MODERATE 41-60%	50	⊠ ..	12	600			
HEAVY 61-80%	70	..	2	140			
SEVERE 81-100%	90						
		TOTALS	40	1287	TOTALS		
AVG. UTIL. = $\frac{\Sigma(C)(M)^*}{\Sigma C}$		$\frac{1287}{40}$ = 32%			——— =		

Herbaceous Utilization Classes. (Browse utilization classes are on the other side.)

1. No use (0-5%). The rangeland shows no evidence of grazing use, or the rangeland has the appearance of negligible grazing.

2. Slight (6-20%). The rangeland has the appearance of very light grazing. The key herbaceous forage plants may be topped or slightly used. Current seedstalks and young plants of key herbaceous species are little disturbed.

3. Light (21-40%). The rangeland may be topped, skimmed, or grazed in patches. The low value herbaceous plants are ungrazed and 60 to 80 percent of the number of current seedstalks of key herbaceous plants remain intact. Most young plants are undamaged.

4. Moderate (41-60%). The rangeland appears entirely covered as uniformly as natural features and facilities will allow. Fifteen to 25 percent of the number of current seedstalks of key herbaceous species remain intact. No more than 10 percent of the number of low value herbaceous forage plants are utilized. (Moderate use does not imply proper use.)

5. Heavy (61-80%). The rangeland has the appearance of complete search. Key herbaceous species are almost completely utilized with less than 10 percent of the current seedstalks remaining. Shoots of rhizomatous grasses are missing. More than 10 percent of the number of low value herbaceous forage plants have been utilized.

6. Severe (81-100%). The rangeland has a mown appearance and there are indications of repeated coverage. There is no evidence of reproduction or current seedstalks of key herbaceous species. Key herbaceous forage species are completely utilized. The remaining stubble of preferred grasses is grazed to the soil surface.

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

The ranch foreman, Bud Gloss, participated in the collection of the utilization data. He felt that the average % utilization obtained by the study accurately reflected the amount of use.

*WHERE C = THE NUMBER OF OBSERVATIONS WITHIN EACH CLASS INTERVAL (C COLUMN), M = THE CLASS INTERVAL MIDPOINT (M COLUMN), AND Σ = THE SUMMATION SYMBOL.

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UTILIZATION STUDY DATA
HEIGHT-WEIGHT METHOD

STUDY NUMBER	DATE	EXAMINER

ALLOTMENT NAME & NUMBER	PASTURE

KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE

KEY SPECIES

	HEIGHT		%		HEIGHT		%		HEIGHT		%		HEIGHT		%		CULM	CULMLESS
NO	UNGRA	GRAZE	UTILIZA	NO	UNGRA	GRAZE	UTILIZA	NO	UNGRA	GRAZE	UTILIZA	NO	UNGRA	GRAZE	UTILIZA		
1				16				31				46					
2				17				32				47					
3				18				33				48					
4				19				34				49					
5				20				35				50					
6				21				36				51					
7				22				37				52					
8				23				38				53					
9				24				39				54					
10				25				40				55					
11				26				41				56					
12				27				42				57					
13				28				43				58					
14				29				44				59					
15				30				45				60					

NUMBER OF UNGRAZ PLANTS	TOTAL HEIGHT OF UNGRAZED PLANTS	NUMBER OF SAMPLED PLANTS	TOTAL % UTIL FOR ALL SAMPLED PLANTS

$$\frac{\text{TOTAL HEIGHT OF UNGRAZED PLANTS}}{\text{NUMBER OF UNGRAZED PLANTS}} = \text{AVERAGE UNGRAZED PLANT HEIGHT} \quad \frac{\quad}{\quad} =$$

$$\frac{\text{TOTAL PERCENT UTILIZATION}}{\text{NUMBER OF SAMPLED PLANTS}} = \text{AVERAGE UTILIZATION} \quad \frac{\quad}{\quad} =$$

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

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UTILIZATION STUDY DATA
HEIGHT-WEIGHT METHOD

STUDY NUMBER	DATE	EXAMINER
(D-3-21) 8 Bac - 1	7/21/84	JACK BORDER

ALLOTMENT NAME & NUMBER	PASTURE
MEDICINE CREEK - 1082	SPRING WATER

KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE
CATTLE - Cows & CALVES	7/1 to 9/30

KEY SPECIES STC04 — CULM [X] CULMLESS [ ]

NO	HEIGHT UNGRAZE	HEIGHT GRAZE	% UTILIZA	NO	HEIGHT UNGRAZ	HEIGHT GRAZE	% UTILIZA	NO	HEIGHT UNGRAZ	HEIGHT GRAZE	% UTILIZA	NO	HEIGHT UNGRAZ	HEIGHT GRAZE	% UTILIZA
1		6	10	16	13		0	31		3	30	46		2	43
2		4	21	17		4	21	32	10		0	47	16		0
3	14		0	18	9		0	33		5	14	48	15		0
4		8	5	19		5	14	34	14		0	49		3	30
5	10		0	20		3	30	35	14		0	50		2	43
6		7	7	21		4	21	36		3	30	51	12		0
7		2	43	22		3	30	37		2	43	52		4	21
8		8	5	23	16		0	38		4	21	53	14		0
9	11		0	24		2	43	39		1	71	54		5	14
10		4	21	25		7	7	40		6	10	55		1	71
11		6	10	26	13		0	41		3	30	56		3	30
12	13		0	27	14		0	42		2	43	57	10		0
13	15		0	28		5	14	43	13		0	58		2	43
14		8	5	29		4	21	44		4	21	59	14		0
15		2	43	30	12		0	45		3	30	60		3	30

NUMBER OF UNGRAZ PLANTS	TOTAL HEIGHT OF UNGRAZED PLANTS	NUMBER OF SAMPLED PLANTS	TOTAL % UTIL FOR ALL SAMPLED PLANTS
21	272	60	1029

TOTAL HEIGHT OF UNGRAZED PLANTS / NUMBER OF UNGRAZED PLANTS = AVERAGE UNGRAZED PLANT HEIGHT: $\frac{272}{21} = 13$ inches

TOTAL PERCENT UTILIZATION / NUMBER OF SAMPLED PLANTS = AVERAGE UTILIZATION: $\frac{1029}{60} = 17\%$

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

Illustration 6
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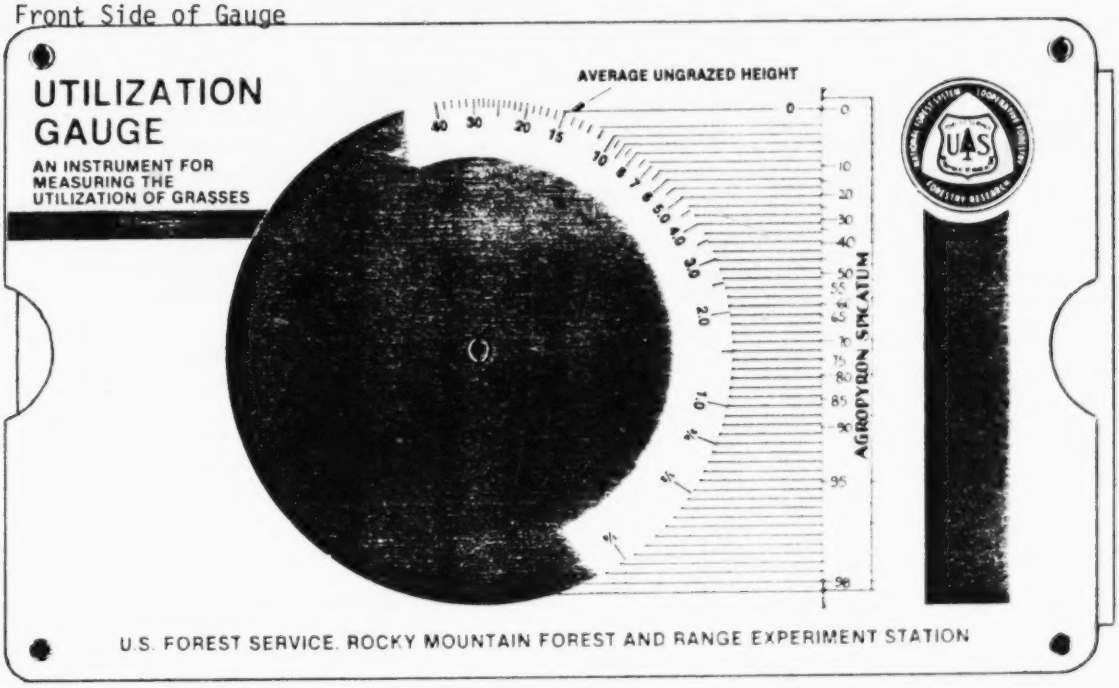
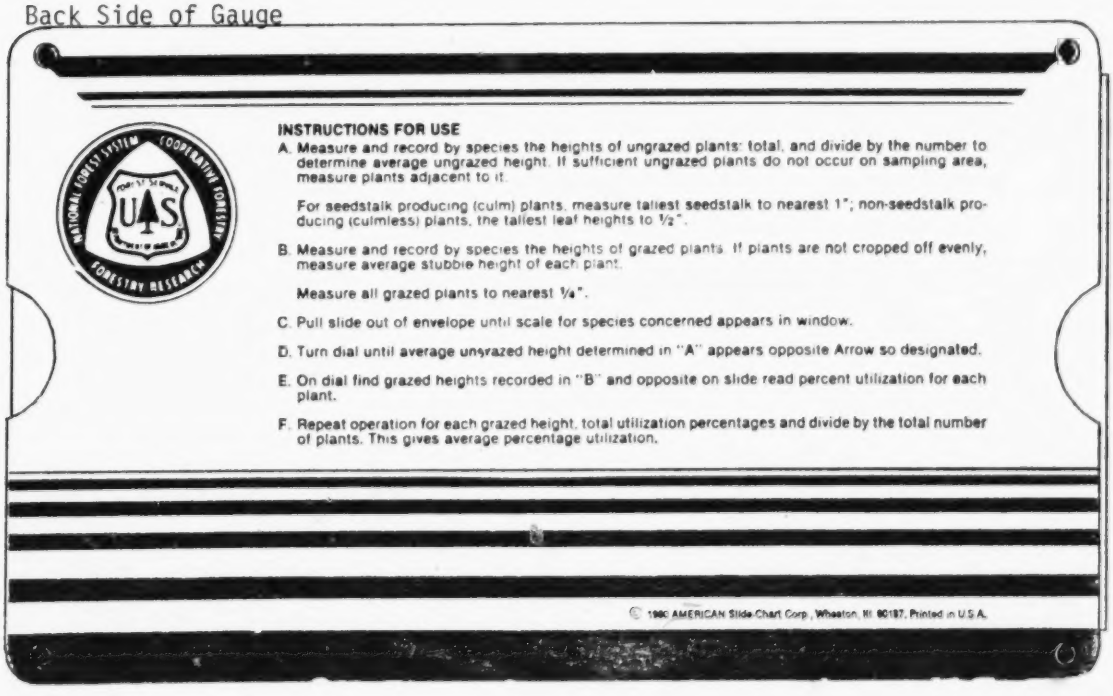
RANGELAND MONITORING - UTILIZATION STUDIES

UTILIZATION GAUGE

Front Side of Gauge


UTILIZATION GAUGE
AN INSTRUMENT FOR MEASURING THE UTILIZATION OF GRASSES
AVERAGE UNGRAZED HEIGHT
40 30 20 15 10 8 7 6 5.0 4.0 3.0 2.0 1.0 ¾ ½ ¼
0 10 20 30 40 50 55 60 65 70 75 80 85 90 95 98
AGROPYRON SPICATUM
U.S. FOREST SERVICE. ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

Back Side of Gauge

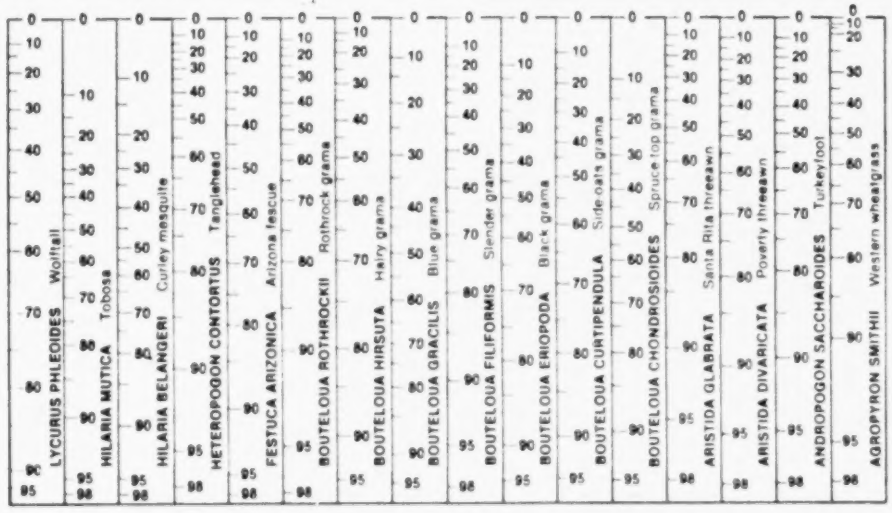

INSTRUCTIONS FOR USE
A. Measure and record by species the heights of ungrazed plants: total, and divide by the number to determine average ungrazed height. If sufficient ungrazed plants do not occur on sampling area, measure plants adjacent to it.
For seedstalk producing (culm) plants, measure tallest seedstalk to nearest 1"; non-seedstalk producing (culmless) plants, the tallest leaf heights to ½".
B. Measure and record by species the heights of grazed plants. If plants are not cropped off evenly, measure average stubble height of each plant.
Measure all grazed plants to nearest ¼".
C. Pull slide out of envelope until scale for species concerned appears in window.
D. Turn dial until average ungrazed height determined in "A" appears opposite Arrow so designated.
E. On dial find grazed heights recorded in "B" and opposite on slide read percent utilization for each plant.
F. Repeat operation for each grazed height, total utilization percentages and divide by the total number of plants. This gives average percentage utilization.
© 1980 AMERICAN Slide-Chart Corp., Wheaton, Ill. 60187. Printed in U.S.A.

RANGELAND MONITORING - UTILIZATION STUDIES

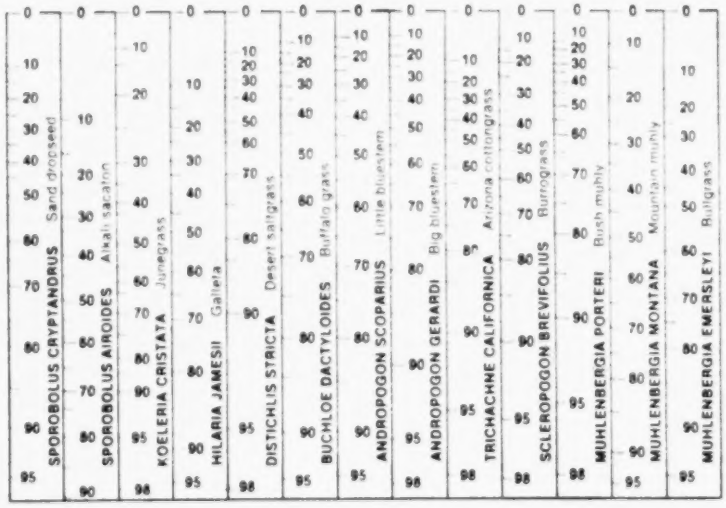
UTILIZATION GAUGE (continued)

These utilization scales must be checked to see whether or not they fit the species on the rangeland where they will be used.

Front Side of Card



Back Side of Card

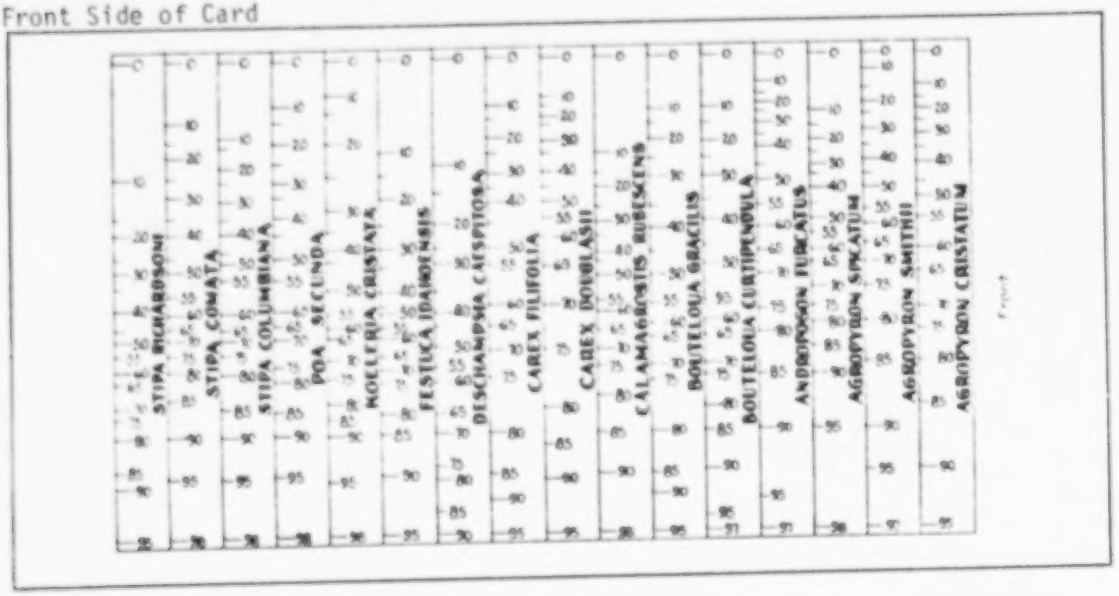


RANGELAND MONITORING - UTILIZATION STUDIES

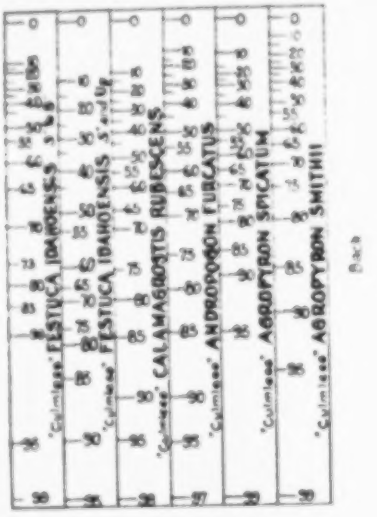
UTILIZATION GAUGE (continued)

These utilization scales must be checked to see whether or not they fit the species on the rangeland where they will be used.

Front Side of Card



Back Side of Card



RANGELAND MONITORING - UTILIZATION STUDIES

EXAMPLE DATA SET FOR DETERMINING HEIGHT-WEIGHT RELATIONSHIPS FOR PREPARING UTILIZATION SCALES

Height Segment (percent)	Dry Weight by Height Segment (grams)	Cumulative Dry Weight (grams)	Cumulative % Height Removed	Cumulative % Weight Removed
0-10	2.8	2.8	10	0.9
11-20	5.6	8.4	20	2.6
21-30	7.0	15.4	30	4.8
31-40	8.4	23.8	40	7.4
41-50	15.4	39.2	50	12.2
51-60	22.1	61.3	60	19.0
61-70	38.3	99.6	70	30.9
71-80	54.6	154.2	80	47.8
81-90	75.7	229.9	90	71.3
91-100	92.6	322.5	100	100.0
	322.5			

Illustration 8

RANGELAND MONITORING - UTILIZATION STUDIES

EXAMPLE HEIGHT-WEIGHT CURVE USED FOR PREPARING UTILIZATION SCALES

Scientific Name and Code -

Common Name -

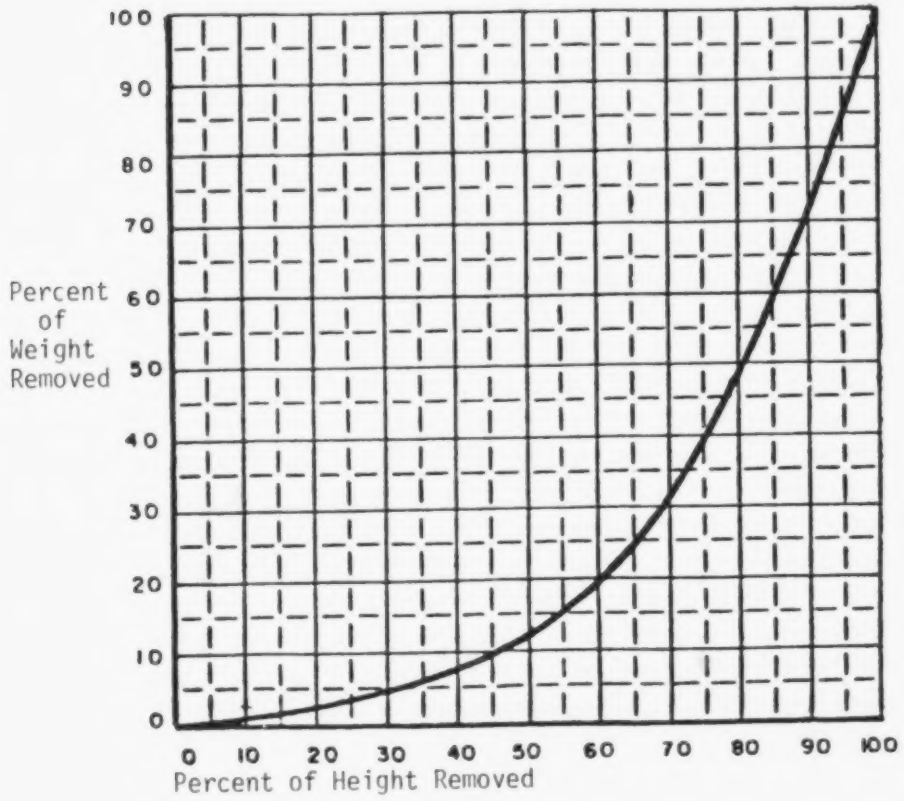
Culm Producing or Culmless Plants -

Allotment Name and Number -

Resource Area -

District -

Date -



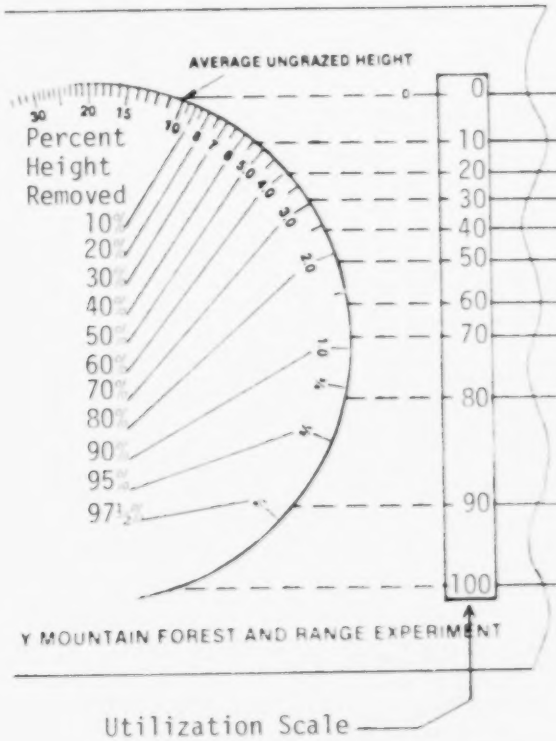
RANGELAND MONITORING - UTILIZATION STUDIES

METHOD FOR TRANSFERRING DATA FROM HEIGHT-WEIGHT CURVES TO UTILIZATION SCALES

Scientific Name and Code -

Common Name -

Date -



0% Height Removed - 0% Utilized
46% " " - 10% "
61% " " - 20% "
69% " " - 30% "
76% " " - 40% "
81% " " - 50% "
86% " " - 60% "
89% " " - 70% "
93% " " - 80% "
97% " " - 90% "
100% " " - 100% "

The percent height removed when 10%, 20%, etc., of the weight is removed is determined from the height-weight curve. (See Illustration 8.)

Illustration 10
Page 1

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

UTILIZATION STUDY DATA
ACTUAL WEIGHT METHOD

STUDY NUMBER	DATE	EXAMINER

ALLOTMENT NAME & NUMBER	PASTURE

KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE

KEY SPECIES

SEE OTHER SIDE FOR EXPLANATION OF THE STEPS FOR CALCULATING PERCENT UTILIZATION.

	NUMBER OF PLANTS	TOTAL WEIGHT* (GRAMS)				
PLANTS GRAZED			STEP 1	———	=	GRAMS PER UNGRAZED PLANT
			STEP 2	X	=	GRAMS (WEIGHT OF ALL PLANTS AS IF NONE HAD BEEN GRAZED)
UNGRAZED			STEP 3	——— X 100	=	% OF WEIGHT REMAINING
TOTALS			STEP 4	100% -	=	% UTILIZATION

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

KEY SPECIES

SEE OTHER SIDE FOR EXPLANATION OF THE STEPS FOR CALCULATING PERCENT UTILIZATION.

	NUMBER OF PLANTS	TOTAL WEIGHT* (GRAMS)				
PLANTS GRAZED			STEP 1	———	=	GRAMS PER UNGRAZED PLANT
			STEP 2	X	=	GRAMS (WEIGHT OF ALL PLANTS AS IF NONE HAD BEEN GRAZED)
UNGRAZED			STEP 3	——— X 100	=	% OF WEIGHT REMAINING
TOTALS			STEP 4	100% -	=	% UTILIZATION

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

*MINUS THE WEIGHT OF THE SACK

CALCULATE PERCENT UTILIZATION AS FOLLOWS:

STEP 1. CALCULATE THE AVERAGE WEIGHT OF UNGRAZED PLANTS.

$$\frac{\text{Total weight of ungrazed plants}}{\text{Total number of ungrazed plants}} = \text{Average weight of ungrazed plants}$$

STEP 2. CALCULATE THE TOTAL WEIGHT OF ALL CLIPPED PLANTS AS IF NONE HAD BEEN GRAZED.

Total number of plants clipped (both grazed and ungrazed) x Average weight of ungrazed plants = Total weight of all clipped plants as if none had been grazed

STEP 3. CALCULATE THE PERCENT OF TOTAL PRODUCTION (WEIGHT) REMAINING.

$$\frac{\text{Total weight of clipped plants (grazed and ungrazed)}}{\text{Total weight of all clipped plants as if none had been grazed}} \times 100 = \text{Percent of total production (weight) remaining}$$

STEP 4. CALCULATE THE PERCENT UTILIZED.

100% - Percent of total production (weight) remaining = Percent utilized

Illustration 10
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UTILIZATION STUDY DATA
ACTUAL WEIGHT METHOD

STUDY NUMBER	DATE	EXAMINER
RED BUTTE #3	9/15/84	JORGE GRANT

ALLOTMENT NAME & NUMBER	PASTURE
RED BUTTE - 0673	LITTLE RED

KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE
CATTLE - Cows & CALVES	6/16 to 9/15

KEY SPECIES: FEID

PLANTS	NUMBER OF PLANTS	TOTAL WEIGHT* (GRAMS)
GRAZED	43	154
UNGRAZED	17	142
TOTALS	60	296

SEE OTHER SIDE FOR EXPLANATION OF THE STEPS FOR CALCULATING PERCENT UTILIZATION.

STEP 1: $\frac{142}{17} = 8.4$ GRAMS PER UNGRAZED PLANT

STEP 2: $60 \times 8.4 = 504$ GRAMS (WEIGHT OF ALL PLANTS AS IF NONE HAD BEEN GRAZED)

STEP 3: $\frac{296}{504} \times 100 = 59$ % OF WEIGHT REMAINING

STEP 4: $100\% - 59 = 41$ % UTILIZATION

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

The permittee, Sam Johns, did an excellent job of spreading the salt in this pasture. It helped pull the cattle into areas that were not used last year.

KEY SPECIES

PLANTS	NUMBER OF PLANTS	TOTAL WEIGHT* (GRAMS)
GRAZED		
UNGRAZED		
TOTALS		

SEE OTHER SIDE FOR EXPLANATION OF THE STEPS FOR CALCULATING PERCENT UTILIZATION.

STEP 1: _____ = GRAMS PER UNGRAZED PLANT

STEP 2: X = GRAMS (WEIGHT OF ALL PLANTS AS IF NONE HAD BEEN GRAZED)

STEP 3: _____ X 100 = % OF WEIGHT REMAINING

STEP 4: 100% - = % UTILIZATION

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

*MINUS THE WEIGHT OF THE SACK

UNITED STATES
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UTILIZATION STUDY DATA
STEM COUNT METHOD

STUDY NUMBER	DATE	EXAMINER

ALLOTMENT NAME & NUMBER	PASTURE

KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE

KEY SPECIES — STEM COUNT BY PLOT

PLOT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTALS
GRAZED																
UNGRAZED																

PLOT	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTALS
GRAZED																
UNGRAZED																

PLOT	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	TOTALS
GRAZED																
UNGRAZED																

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

TOTAL GR STEMS	TOTAL GR + UNGR STEMS

$$\frac{\text{GRAZED STEMS}}{\text{TOTAL STEMS}} \times 100 = \%\ \text{UTILIZATION} \qquad \frac{\text{(STEMS GRAZED)}}{\text{}} \times 100 =$$

Illustration 11
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UTILIZATION STUDY DATA
STEM COUNT METHOD

STUDY NUMBER	DATE	EXAMINER
13N - 41E - 27 - 04	9/30/84	Bob JACKSTRAW

ALLOTMENT NAME & NUMBER	PASTURE
BLUE RIDGE - 0079	CHOKECHERRY

KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE
HORSES	5/1 to 9/30

KEY SPECIES AGSM — STEM COUNT BY PLOT

PLOT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTALS
GRAZED	5	6	4	7	8	5	6	2	5	3	3	4	9	9	6	82
UNGRAZED	3	8	9	0	6	10	8	9	5	6	8	1	5	3	2	83

PLOT	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTALS
GRAZED	5	8	7	9	6	8	5	9	9	7	7	4	5	7	4	100
UNGRAZED	9	3	2	5	2	3	3	0	0	6	2	0	1	2	1	39

PLOT	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	TOTALS
GRAZED	5	2	3	7	7	5	7	4	6	10	4	5	3	6	2	76
UNGRAZED	5	9	8	0	2	9	2	9	1	1	1	10	6	2	9	74

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

The horses have trampled the area around the undeveloped chokecherry spring until it is nothing but a mud hole. The spring head should be fenced and the water piped to a trough.

TOTAL GR STEMS: 258 | TOTAL GR + UNGR STEMS: 454

$\frac{\text{GRAZED STEMS}}{\text{TOTAL STEMS}} \times 100 = \%$ UTILIZATION (STEMS GRAZED) $\frac{258}{454} \times 100 = 57\%$

Illustration 12
Page 1

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UTILIZATION STUDY DATA
GRAZED-CLASS METHOD

STUDY NUMBER	DATE	EXAMINER

ALLOTMENT NAME & NUMBER	PASTURE

KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE

GRAZED CLASS PERCENTS (P)	KEY SPECIES DOT COUNT	KEY SPECIES NO BY CLASS (C)	KEY SPECIES NO X CLASS %(C)(P)	KEY SPECIES DOT COUNT	KEY SPECIES NO BY CLASS (C)	KEY SPECIES NO X CLASS %(C)(P)	KEY SPECIES DOT COUNT	KEY SPECIES NO BY CLASS (C)	KEY SPECIES NO X CLASS %(C)(P)
0									
10									
30									
50									
70									
90									
	TOTALS			TOTALS			TOTALS		
AVG. UTIL. $= \frac{\Sigma(CP)*}{\Sigma C}$		=			=			=	

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

*WHERE C = THE NUMBER OF PLANTS WITHIN EACH CLASS (C COLUMN),
P = THE GRAZED-CLASS PERCENTAGES (P COLUMN), AND Σ = THE SUMMATION SYMBOL.

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UTILIZATION STUDY DATA
GRAZED-CLASS METHOD

STUDY NUMBER	DATE	EXAMINER
SANDY ARROYO #2	10/30/84	ABNER SOUTHGATE

ALLOTMENT NAME & NUMBER	PASTURE
SANDY ARROYO - 0719	CREOSOTE KNOB

KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE
CATTLE - YEARLINGS	8/1 to 12/31

GRAZED CLASS PERCENTS (P)	KEY SPECIES: BOGR2 DOT COUNT	NO BY CLASS (C)	NO X CLASS % (C)(P)	KEY SPECIES DOT COUNT	NO BY CLASS (C)	NO X CLASS % (C)(P)	KEY SPECIES DOT COUNT	NO BY CLASS (C)	NO X CLASS % (C)(P)
0	⊠··	12	0						
10	⊠⊏	17	170						
30	⊠⊠⊠:	32	960						
50	⊠⊓.	16	800						
70	:·	3	210						
90									
	TOTALS	80	2140	TOTALS			TOTALS		
AVG. UTIL. $= \frac{\Sigma(CP)^*}{\Sigma C}$	$\frac{2140}{80} = 27\%$			——— =			——— =		

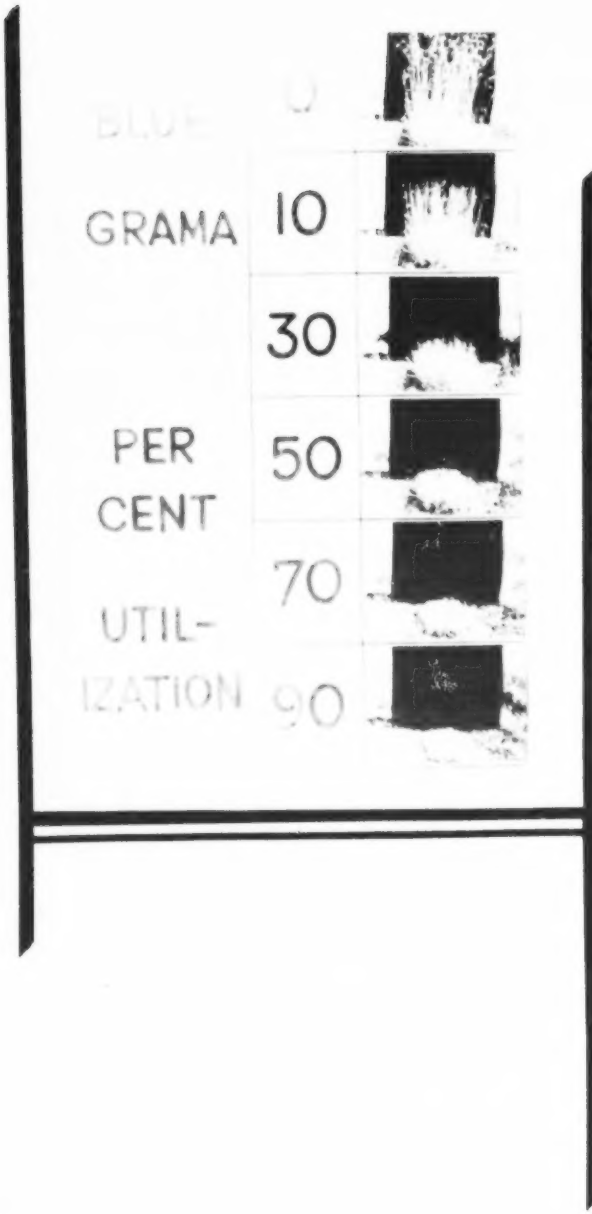
NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

The yearlings are scattered throughout the pasture - good distribution. Roadrunner Spring is just about dry; when it dries up, there will be no water in the northwest corner of the pasture.

*WHERE C = THE NUMBER OF PLANTS WITHIN EACH CLASS (C COLUMN), P = THE GRAZED-CLASS PERCENTAGES (P COLUMN), AND Σ = THE SUMMATION SYMBOL.

RANGELAND MONITORING - UTILIZATION STUDIES

EXAMPLES OF GRAZED-CLASS METHOD PHOTO GUIDES



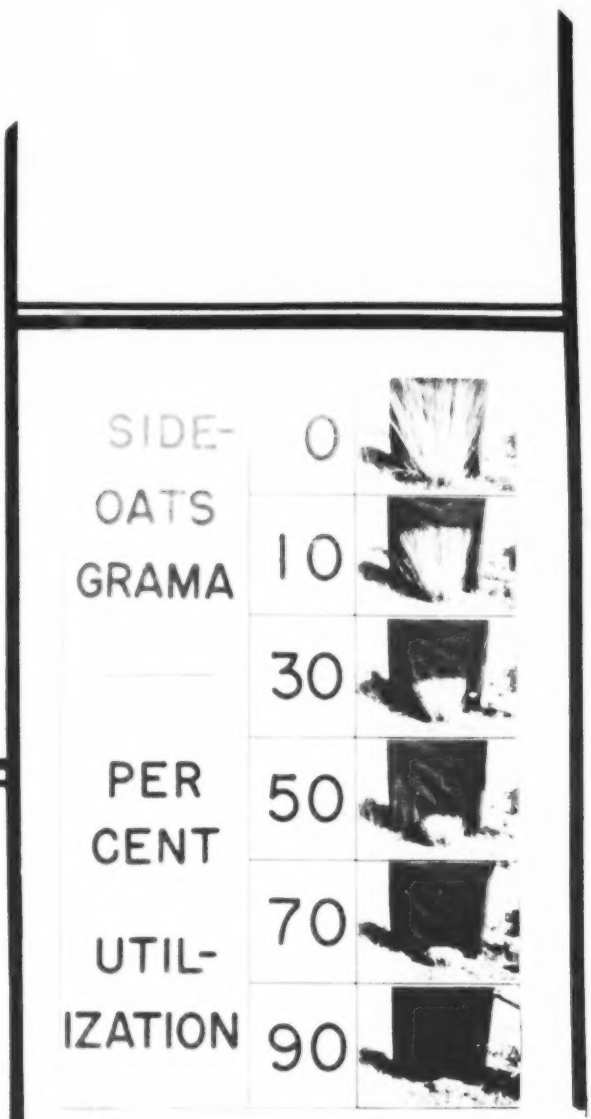


Illustration 14

RANGELAND MONITORING - UTILIZATION STUDIES

EXAMPLE DATA SET FOR DETERMINING HEIGHT-WEIGHT RELATIONSHIPS FOR DEVELOPING PHOTO GUIDES

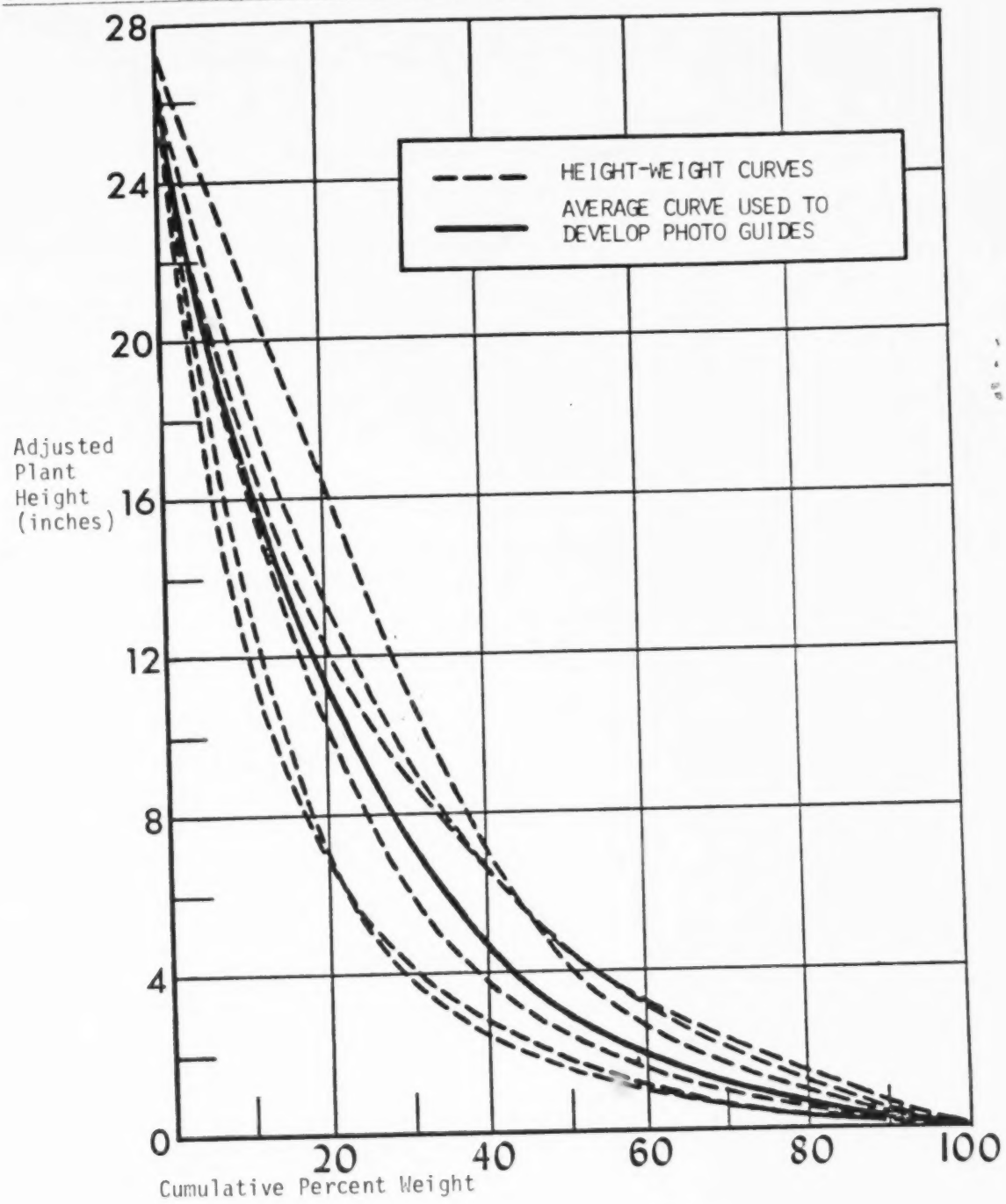
Scientific Name & Code _____

Plant Number _____ Date _____

Segment Number (from top down)	Segment Length (inches)	Dry Weight by Plant Segment (grams)	Cumulative Dry Weight (grams)	Cumulative Percent Weight	Cumulative Height Remaining (inches)	Adjusted Height Remaining (inches)
-	-	-	-	0	21.5	26.0
1	6.5	.9	.9	7.5	15.0	18.1
2	4.0	.9	1.8	15.0	11.0	13.3
3	3.0	.7	2.5	20.8	8.0	9.7
4	2.0	.7	3.2	26.7	6.0	7.3
5	2.0	.9	4.1	34.2	4.0	4.8
6	2.0	1.9	6.0	50.0	2.0	2.4
7	2.0	6.0	12.0	100.0	0	0
	21.5	12.0				

RANGELAND MONITORING - UTILIZATION STUDIES

EXAMPLE HEIGHT-WEIGHT CURVE USED FOR DETERMINING AVERAGE PLANT HEIGHT FOR THE SIX GRAZED-CLASS PERCENTAGES ON PHOTO GUIDES.



UNITED STATES
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UTILIZATION STUDY DATA
TWIG LENGTH MEASUREMENT METHOD

STUDY NUMBER	DATE	EXAMINER	KIND AND/OR CLASS OF ANIMAL

KEY SPECIES	ALLOTMENT NAME & NUMBER	PASTURE	PERIOD OF USE

TAG NO	MEASUREMENTS AFTER FULL ANNUAL GROWTH — NEAREST 1/2 INCH [_] CENTIMETER [_]														MEASUREMENTS AFTER PERIOD OF USE													% USE BY PLNT
	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL LNGTH	ESTI USE	NO TWIG MEAS	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL LNGTH	

CALCULATIONS:

1. AVERAGE ESTIMATED USE PRIOR TO COMPLETION OF FULL ANNUAL GROWTH

$$\frac{\text{Total estimated \% utilization for the individual plants}}{\text{No. of tagged plants}} = \text{Average estimated use prior to completion of full annual growth}$$

_____ =

2. PERCENT UTILIZATION BY PLANT

$$\frac{\text{Total twig length by plant after full annual growth} - \text{Total twig length by plant after period of use}}{\text{Total twig length by plant after full annual growth}} \times 100 = \text{Percent utilization}$$

_____ - _____ x 100 =

3. AVERAGE PERCENT UTILIZATION

$$\frac{\text{Total percent utilization for the individual plants}}{\text{No. of tagged plants}} = \text{Average percent utilization}$$

_____ =

4. TOTAL PERCENT UTILIZATION

$$\text{Average estimated use prior to completion of full annual growth} + \text{Average percent utilization} = \text{Total percent utilization}$$

+ =

5. GROWTH INDEX

$$\frac{\text{Total twig length for all tagged plants after full annual growth}}{\text{No. of twigs measured}} = \text{Growth index (Average twig length)}$$

_____ =

6. ADJUSTED GROWTH INDEX

$$\frac{\text{Growth index}}{100\% - \text{Average estimated use prior to completion of full annual growth}} \times 100 = \text{Adjusted growth index}$$

_____ x 100 =

7. USE INDEX

$$\frac{\text{Total percent utilization} \times \text{Adjusted growth index}}{100} = \text{Use index}$$

$$\frac{x}{100} =$$

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UTILIZATION STUDY DATA
TWIG LENGTH MEASUREMENT METHOD

STUDY NUMBER	DATE	EXAMINER	KIND AND/OR CLASS OF ANIMAL
04N-07W-17-03	9/1/84 11/30/84	Billy Joe	CATTLE

KEY SPECIES	ALLOTMENT NAME & NUMBER	PASTURE	PERIOD OF USE
PUTR2	CHICKEN CREEK-0573		8/1 to 11/30

	MEASUREMENTS AFTER FULL ANNUAL GROWTH (NEAREST 1/2 INCH ☒ CENTIMETER ☐)														MEASUREMENTS AFTER PERIOD OF USE													
TAG NO	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL LNGTH	EST USE	NO TWIG MEAS	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL LNGTH	% USE BY PLNT
1	5½	5	6	7	6½	6	7	5½	6	6½			61		10	5½	5	6	7	6	5	5	2	4	2			47½	22
2	7	5½	6	6½	7	6	6½	5½	7	5½			62½		10	7	5½	6	6½	7	6	6½	4	5	4			57½	8
3	6½	6	6½	5½	6½	5	6	4	5½	6	5	6½	69		12	6½	6	6½	5½	5	5	5	4	4½	4½	4	4	60½	12
4	6½	7	6	6½	5½	5	6	5½	4	3½	2		57½	5	11	6½	7	6	6½	4½	4	6	5	3½	2	1		52	10
5	5½	6	6	6½	5½	6	7	4	6½	5			58		10	5½	6	6	6½	5½	4	3	4	3½	2			46	21
6	7½	6	5½	6½	7	6	6½	3	5½	6	5½		65		11	7½	6	5½	6½	7	6	6½	3	4	3½	5		60½	7
7	5½	7	7½	6	7	6½	6	6½	3	5½			60½		10	5½	7	7½	6	7	6½	6	6½	3	5½			60½	0
8	4	6½	5½	6	6½	4	3	4½	5	6	3	1	55	5	12	4	6½	5½	6	6½	4	3	4½	4	4	2	½	50½	8
9	6	4	4½	5½	5½	5	5½	6	4	7			53		10	6	4	4½	5½	5½	5	5½	6	4	5½			51½	3
10	6	5	6½	4	3½	7	6	6	6	3			53	5	10	6	5	6½	4	3½	7	6	3	2	2			45	15
11	6	5½	8	6	6½	5½	7	4½	6	6½			61½		10	6	5½	8	6	6½	5½	7	4	3½	4			56	9
12	5½	3	7	7½	5	6½	4	6½	5	4½			54½		10	5½	3	7	7½	5	6½	4	6½	5	4½			54½	0
13	7	7½	6	8	5½	7	4	5½	6½	7	6	5½	75½		12	7	7½	6	8	5½	7	4	5½	6½	5½	6	4	72½	4
												TOTALS	786	15	138												TOTALS	714½	119

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

(INSTRUCTIONS FOR CALCULATIONS ON OTHER SIDE)

CALCULATIONS:

1. AVERAGE ESTIMATED USE PRIOR TO COMPLETION OF FULL ANNUAL GROWTH

$$\frac{\text{Total estimated \% utilization for the individual plants}}{\text{No. of tagged plants}} = \text{Average estimated use prior to completion of full annual growth}$$

$$\frac{15}{13} = 1\%$$

2. PERCENT UTILIZATION BY PLANT

$$\frac{\text{Total twig length by plant after full annual growth} - \text{Total twig length by plant after period of use}}{\text{Total twig length by plant after full annual growth}} \times 100 = \text{Percent utilization}$$

$$\frac{61 - 47\frac{1}{2}}{61} \times 100 = 22\%$$

3. AVERAGE PERCENT UTILIZATION

$$\frac{\text{Total percent utilization for the individual plants}}{\text{No. of tagged plants}} = \text{Average percent utilization}$$

$$\frac{119}{13} = 9\%$$

4. TOTAL PERCENT UTILIZATION

$$\text{Average estimated use prior to completion of full annual growth} + \text{Average percent utilization} = \text{Total percent utilization}$$

$$1 + 9 = 10\%$$

5. GROWTH INDEX

$$\frac{\text{Total twig length for all tagged plants after full annual growth}}{\text{No. of twigs measured}} = \text{Growth index (Average twig length)}$$

$$\frac{786}{138} = 5.7 \text{ inches}$$

6. ADJUSTED GROWTH INDEX

$$\frac{\text{Growth index}}{100\% - \text{Average estimated use prior to completion of full annual growth}} \times 100 = \text{Adjusted growth index}$$

$$\frac{5.7}{100-1} \times 100 = 5.8 \text{ inches}$$

7. USE INDEX

$$\frac{\text{Total percent utilization} \times \text{Adjusted growth index}}{100} = \text{Use index}$$

$$\frac{10 \times 5.8}{100} = .6$$

Illustration 17
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UTILIZATION STUDY DATA
COLE BROWSE METHOD

STUDY NUMBER	DATE	EXAMINER

ALLOTMENT NAME & NUMBER	PASTURE

KEY SPECIES	KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE

PLOT NO	FORM CLASS 1	2	3	4	5	6	7	8	AGE CLASS S	Y	M	D	USE -%	LEADER -%
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
													TOTAL	

TOT	%	FORM CLASSES
		1 - ALL AVAILABLE, LITTLE OR NO HEDGING
		2 - ALL AVAILABLE, MODERATELY HEDGED
		3 - ALL AVAILABLE, SEVERELY HEDGED
		4 - PARTIALLY AVAILABLE, LITTLE OR NO HEDGING
		5 - PARTIALLY AVAILABLE, MODERATELY HEDGED
		6 - PARTIALLY AVAILABLE, SEVERELY HEDGED
		SUBTOTAL
		7 - UNAVAILABLE
		8 - DEAD
		TOTAL

TOT	%	AGE CLASSES
		S - SEEDLING, < 1/8" DIAM.
		Y - YOUNG, 1/8" TO 1/2" DIAM.
		M - MATURE, > 1/2" DIAM.
		D - DECADENT, 50% OR MORE DEAD
		TOTAL

LEADER USE CLASS	VALUE	AVERAGE LEADER USE
0%	0%	
1-10%	5%	
11-40%	25%	
41-60%	50%	
61-90%	75%	
91-100%	95%	

AVERAGE LEADER LENGTH		USE INDEX	

	LEADER LENGTH										TOTAL LENGTH	NO LDRS MEAS
NO	1	2	3	4	5	6	7	8	9	10		
1												
11												
21												
31												
41												
51												
61												
71												
81												
91												
101												
111												
121												
131												
141												
151												
161												
171												
181												
191												
201												
211												
221												
231												
241												
251												
261												
271												
281												
291												
301												
311												
321												
331												
341												
351												
361												
371												
381												
391												
401												
411												
421												
431												
441												
451												
461												
471												
481												
491												
501												
										TOTALS		

TOTAL LENGTH / NO LEADERS MEAS = AVERAGE LEADER LENGTH	_____ =

NOTES (USE ANOTHER PAGE IF NECESSARY)

Illustration 17
Page 2

Illustration 17
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BUREAU OF LAND MANAGEMENT

UTILIZATION STUDY DATA
COLE BROWSE METHOD

STUDY NUMBER	DATE	EXAMINER
135-27E-11-05	2/28/84	Suzie Clump

ALLOTMENT NAME & NUMBER	PASTURE
Purple Ridge - 1234	Mahogany

KEY SPECIES	KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE
CEMO2	Cattle	11/1 to 2/28

PLI NO	FORM CLASS 1	2	3	4	5	6	7	8	AGE CLASS S	Y	M	D	LEADER USE -%
1		X						X			X		50
2			X					X			X		5
3	X					X					X		25
4		X						X			X		25
5		X						X					25
6				X				X					50
7			X					X					25
8					X			X					75
9						X							1
10	X						X						25
11	X						X						25
12					X								1
13			X					X					5
14	X						X						5
15	X						X						25
16						X							1
17		X					X						50
18	X							X					25
19	X							X					25
20		X							X				50
21			X					X					25
22			X					X					5
23						X							1
24	X						X						25
25		X							X				25

PLI NO	FORM CLASS 1	2	3	4	5	6	7	8	AGE CLASS S	Y	M	D	LEADER USE -%
126	X							X		X			5
127	X							X		X			5
128	X							X		X			25
129	X							X		X			50
130	X							X			X		25
131													
132													
133													
134													
135													
136													
137													
138													
139													
140													
141													
142													
143													
144													
145													
146													
147													
148													
149													
150													

TOTAL 705

TOT	%	FORM CLASSES
13	43	1 - ALL AVAILABLE, LITTLE OR NO HEDGING
6	20	2 - ALL AVAILABLE, MODERATELY HEDGED
0	-	3 - ALL AVAILABLE, SEVERELY HEDGED
4	13	4 - PARTIALLY AVAILABLE, LITTLE OR NO HEDGING
2	7	5 - PARTIALLY AVAILABLE, MODERATELY HEDGED
1	3	6 - PARTIALLY AVAILABLE, SEVERELY HEDGED
26	-	SUBTOTAL
2	7	7 - UNAVAILABLE
2	7	8 - DEAD
30	100	TOTAL

TOT	%	AGE CLASSES
3	12	S - SEEDLING, < 1/8" DIAM.
9	35	Y - YOUNG, 1/8" TO 1/2" DIAM.
12	46	M - MATURE, > 1/2" DIAM.
2	7	D - DECADENT, 50% OR MORE DEAD
26	100	TOTAL

LEADER USE CLASS	VALUE	AVERAGE LEADER USE
0%	0%	27%
1-10%	5%	
11-40%	25%	
41-60%	50%	
61-90%	75%	
91-100%	95%	

AVERAGE LEADER LENGTH: 7 inches USE INDEX: 1.9

PL NO	LEADER LENGTH nearest 1/2 inch										TOTAL LENGTH	NO LDRS MEAS
	1	2	3	4	5	6	7	8	9	10		
1	7	6½	8	6½	3	6					37	6
2	8	6	7½	6½	5	7	6	6½			52½	8
3	6½	7	8	5	7½	7	8	5½	6	7½	68	10
4	8	6½	7	7	7	7½	6½	7	6	6	68½	10
5	7½	8	6	7	7	6½	5	7½	7		61½	9
6	7½	7	8	6½	9						38	5
7	7	9	8½	7	8	6½	7				53	7
8	6	7½	7								20½	3
9												—
10	5½	7½	6	8	8½	7	9	7			58½	8
11	7½	8	6	9	5½	6	8	8	8		66	9
12												—
13	7½	9	9	6½	7	8	6	7	9	7	76	10
14	6½	6	7	7	6½	5					38	6
15	6½	7	8	5	7						33½	5
16												—
17	5½	8	7	6½							27	4
18	8	7	8	8	6½	4	7½	7	7	7	70	10
19	9	8½	8½	6	7	6½	5	7	6	6	69½	10
20	8	8½	7	6							29½	4
21	7	9	7½	8	6	5½	7				50	7
22	7	8½	6	6½	7	6½	6	6	6		59½	9
23												—
24	7	6½	5	4½	7	9	9	8	7	8	71	10
25	8½	9	7½	7	7	7	8	8½	6		68½	9
26	8½	6½	9	8½	5	9	6½	8	8	8	77	10
27	6½	7	9	8½	7	7	7½	7	4	8	71½	10
28	5	7½	8	8	8	7	7½	6	9		66	9
29	9	9	8½	7	7	8					48½	6
30	8	6	6½	6	6½	8	7	7			55	8
31												
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48												
49												
50												
										TOTALS	1434	202

NOTES (USE ANOTHER PAGE IF NECESSARY)

Illustration 17
Page 4

TOTAL LENGTH / NO LEADERS MEAS = AVERAGE LEADER LENGTH

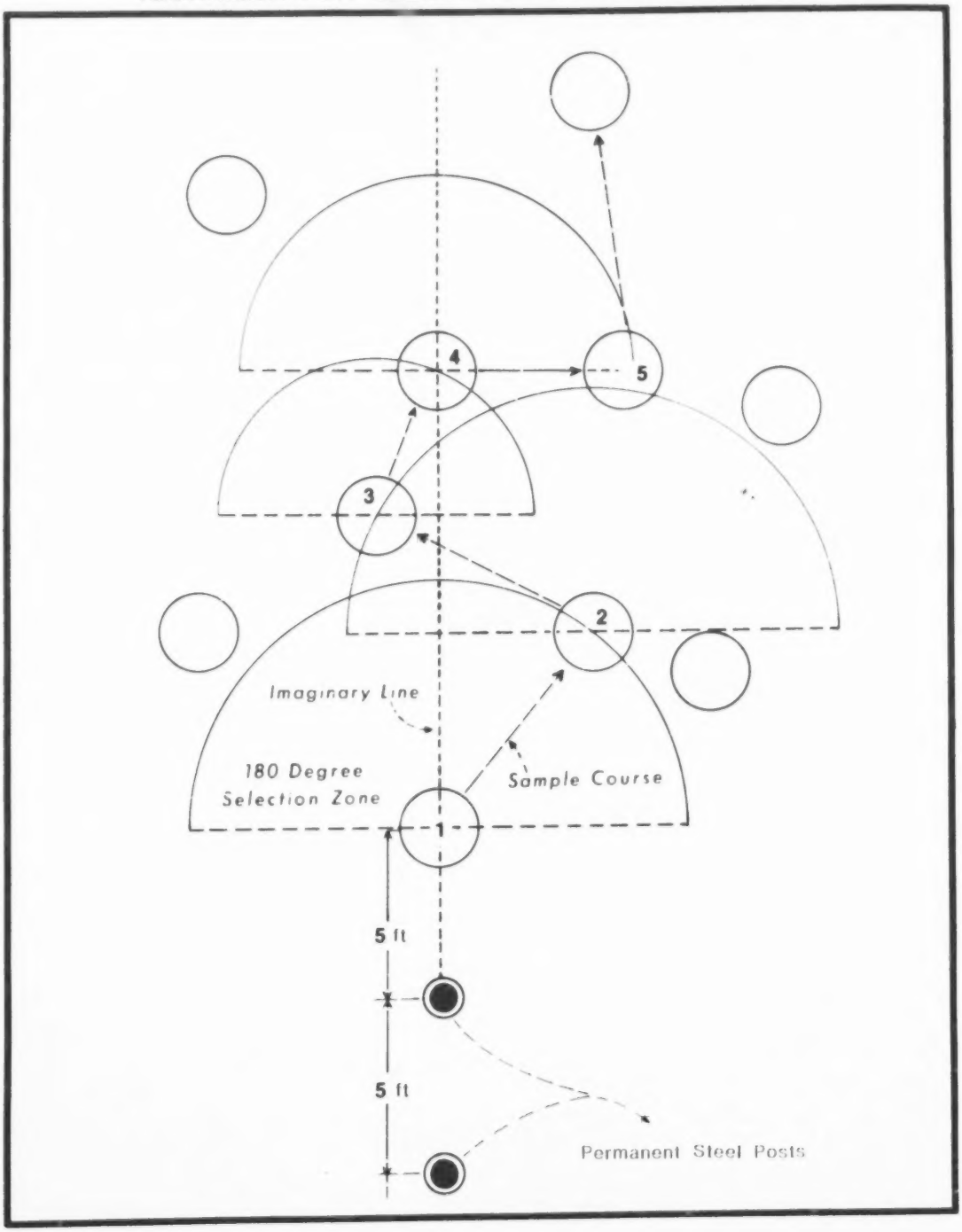
$\frac{1434}{202} = 7$ inches

Illustration 18

RANGELAND MONITORING - UTILIZATION STUDIES

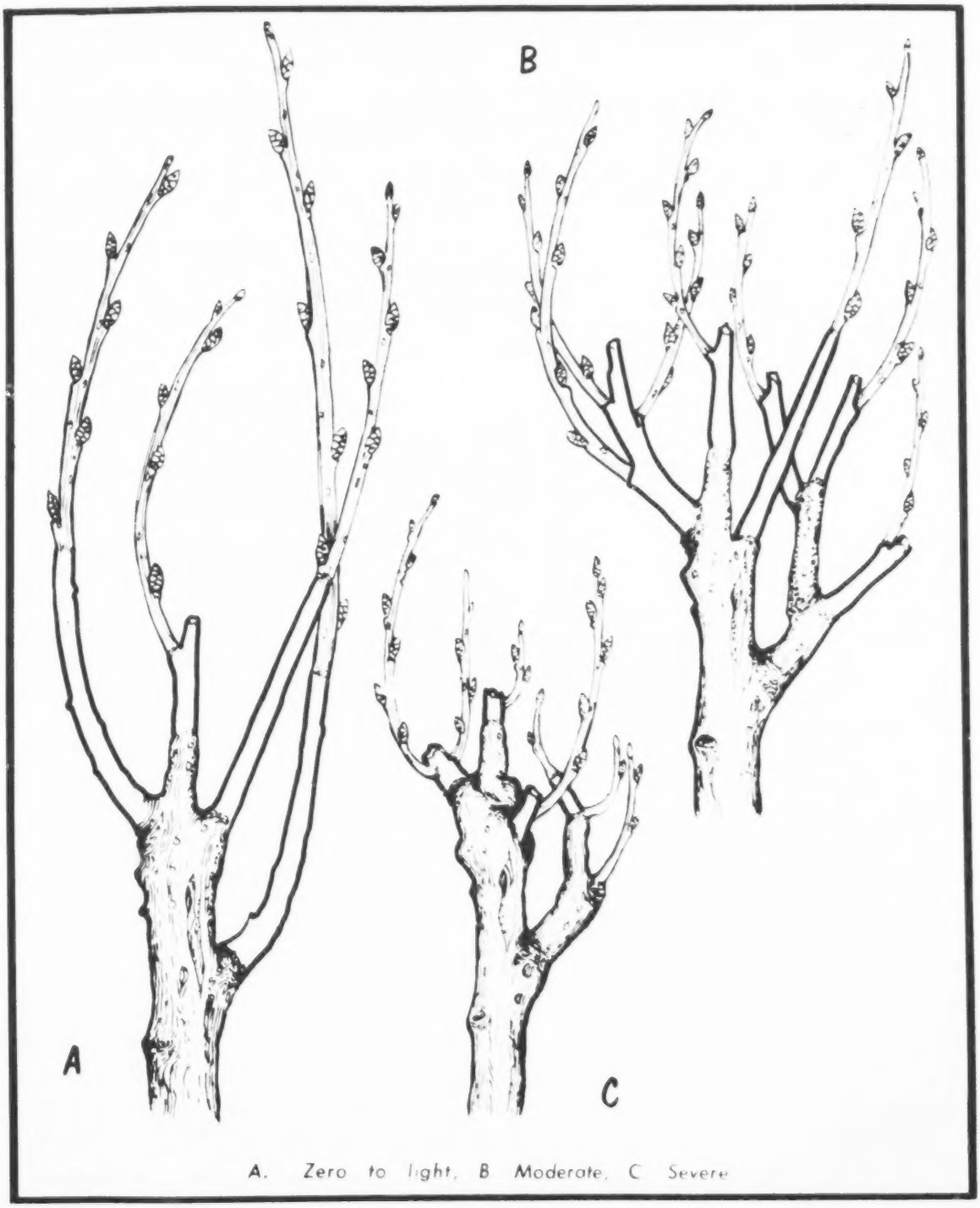
COLE BROWSE METHOD - TRANSECT SCHEMATIC

TECHNIQUE FOR SELECTING THE NEAREST PLANT



RANGELAND MONITORING - UTILIZATION STUDIES

DEGREES OF HEDGING



A. Zero to light, B Moderate, C Severe

Illustration 20
Page 1

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

UTILIZATION STUDY DATA
EXTENSIVE BROWSE METHOD

STUDY NUMBER	DATE	EXAMINER

ALLOTMENT NAME & NUMBER	PASTURE

KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE

	PERCENT UTILIZATION										TOTAL %	NUMBER OF	AVG. %
SPECIES	0	10	20	30	40	50	60	70	80	90	100	UTILIZED	PLANTS	UTILIZ

	AGE CLASS				FORM CLASS								NO PLNT (AND %
SPECIES	S	Y	M	D	1	2	3	4	5	6	7	8	COMP)
TOT NO PLANTS (AND % COMP)													

NOTES (USE OTHER SIDE OR ANOTHER PAGE, IF NECESSARY)

 (INSTRUCTIONS FOR CALCULATIONS ON OTHER SIDE)

Calculating Average Utilization by Species

1. For each species, multiply the number of browse plants tallied in each percentage block by the percent indicated in the column heading (0, 10, 20, 30, etc.). Add the figures from each block to determine total percent utilized.

2. Add the dot tallies for each browse species to determine the total number of plants sampled of that species.

3. Calculate the average percent utilization for each species by dividing the total percent utilized by the total number of plants.

Age Class Summary Calculations

Add the dot tallies for each age class. Because the age class is determined for 100 plants on the transect, these totals represent the percent composition by age class for the browse portion of the plant community.

Form Class Summary Calculations

Add the dot tallies for each form class. Because the form class is determined for 100 plants on the transect, these totals represent the percent composition by form class for the browse portion of the plant community.

Calculating Composition by Species

Add the form class dot tallies for each browse species. Because the form class is determined for 100 plants on the transect, the totals represent the species composition percentages for the browse portion of the plant community.

Illustration 20
Page 3

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

UTILIZATION STUDY DATA
EXTENSIVE BROWSE METHOD

STUDY NUMBER	DATE	EXAMINER
27N - 01E - 19 - 01	3/31/84	SALLY CLUMP

ALLOTMENT NAME & NUMBER	PASTURE
WINDOW ROCK - 2139	BOULDER

KIND AND/OR CLASS OF ANIMAL	PERIOD OF USE
SHEEP	1/15 to 3/21

SPECIES	PERCENT UTILIZATION 0	10	20	30	40	50	60	70	80	90	100	TOTAL % UTILIZED	NUMBER OF PLANTS	AVG. % UTILIZ
PUTR2												3110	60	52
CEMO2												1030	44	23
CHVI8												280	23	12
ARTRV												130	14	9

SPECIES	AGE CLASS S	Y	M	D	FORM CLASS 1	2	3	4	5	6	7	8	NO PLNT (AND % COMP)
PUTR2													19
CEMO2													44
CHVI8													23
ARTRV													14
TOT NO PLANTS (AND % COMP)	5	25	66	4	72	12	2	9	3	2			100

NOTES (USE OTHER SIDE OR ANOTHER PAGE. IF NECESSARY)

RANGELAND MONITORING - UTILIZATION STUDIES

A P P E N D I X

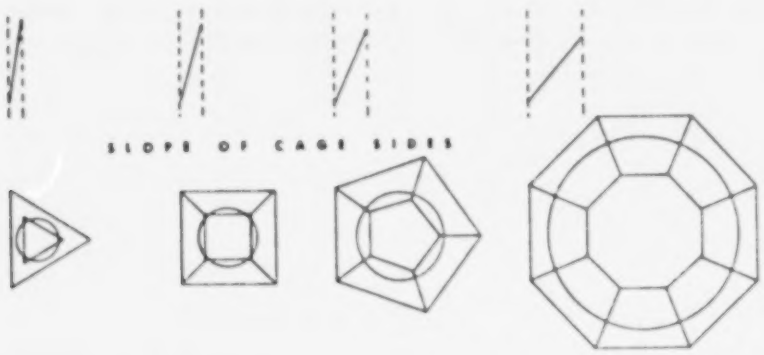
KINDS OF UTILIZATION CAGES

Following are some examples of kinds of cages that can be constructed and used for utilization and production studies. There are many other kinds of cages that will do the job just as well. No specific cage is recommended.

CAGE TYPE 1

Folding cages are adaptable to plots of different sizes. The basic construction employs panels of welded wire, hinged together by No. 9 wire threaded through a series of wire loops at the edges of each panel. The 4-sided cage constitutes the basic design, but the number of panels can be increased to enclose larger areas. A 4-panel cage, 5 ft. sq., accomodates a 9.6 sq. ft. plot, 5 panels accomodate a plot twice that size, and 8 panels accomodate a 96 or 100 sq. ft. plot. Procedures for cutting panels from different types of welded wire are shown on page 2. Cages with an even number of panels will fold flat if the panels are of equal size. If an odd number of panels are used, one hinge wire must be removed to permit the cages to fold flat.

Below are diagrams of four cage structures produced by varying the number of panels. For these cages, the basic panel would be of welded 4 by 4-inch

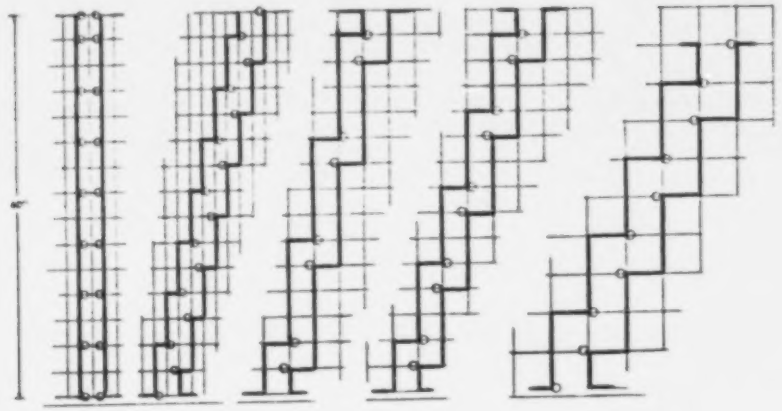


wire mesh cut on the following dimensions: base, 5 feet; height, 5 feet; top, 32 inches. Areas enclosed by circles within each diagram (left to right) correspond to plots of 4.8, 9.6, 19.2, and 96 square feet respectively.

best copy available

RANGELAND MONITORING - UTILIZATION STUDIES

CAGE TYPE 1 (continued)



A	B	C	D	E
90° cut 2" x 4" mesh, 11/11 gage, galvanized.	76° cut 2" x 4" mesh, 11/11 gage, galvanized.	76° cut 4" x 4" mesh, 10/10 gage, galvanized.	71.5° cut 4" x 4" mesh, 10/10 gage, galvanized.	63.3° cut 6" x 6" mesh, 9/9 gage, galvanized.

The above are diagrams for cutting 5 by 5-foot panels from three types of welded wire. Loops are formed from horizontal wires as shown - other wires between panels are cut off.

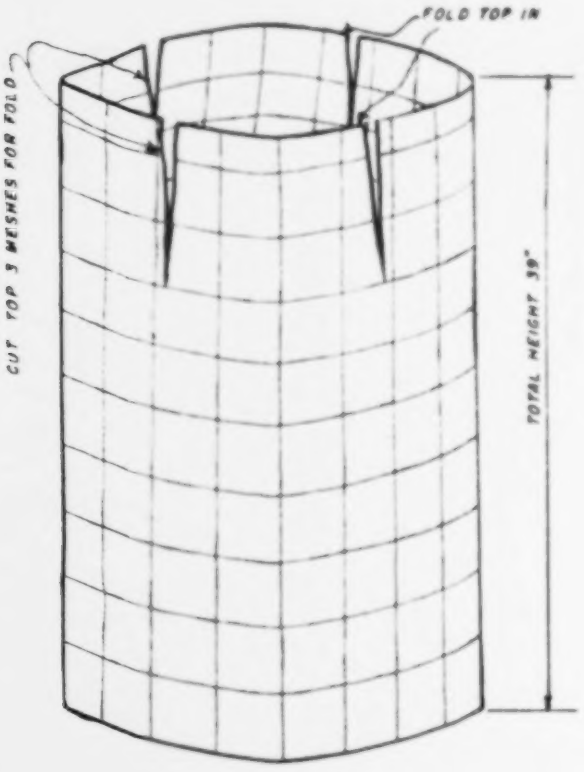
CAGE TYPE 2

A rigid steel post cage can be constructed by driving four steel posts in the ground to mark off the area to be protected. Make the posts sturdy by bracing from one post to another around the perimeter of the cage. Encircle this frame with either net or barbed wire. These cages are very stable but they are difficult to move.

RANGELAND MONITORING - UTILIZATION STUDIES

CAGE TYPE 3

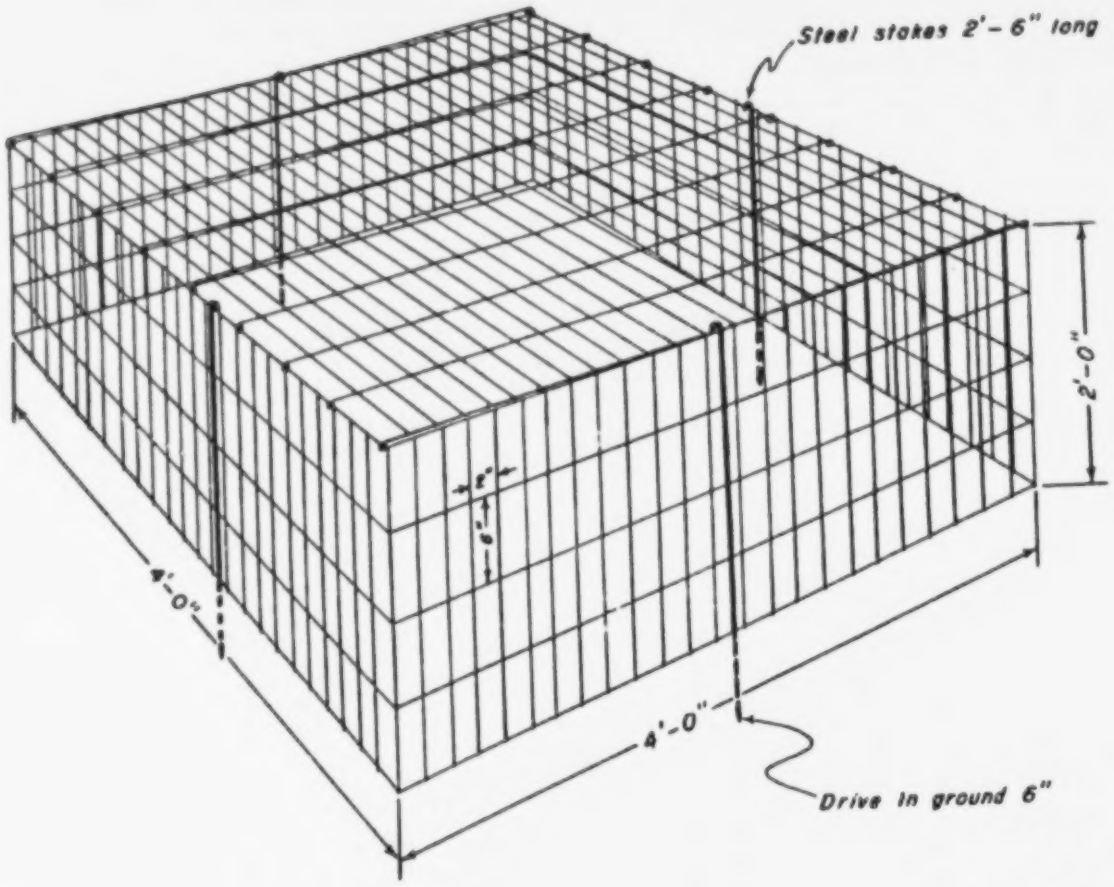
Igloo-shaped wire cages are light in weight, low in cost, portable, and easily placed. The cages are made in sets of four and can be nested. Use 6-inch mesh, 39 inches high. Wire lighter than 11-1/2 gage is unsuitable. To make four nesting cages: lengths of field fence are cut with 23, 24, 25, and 26 meshes intact. Each length is formed into a cylindrical shape and fastened by using the cut ends as ties, except those of the three upper (larger) meshes. The horizontal wires of the three upper meshes are cut at intervals of 90 degrees so that four nearly-equal flaps are formed. These are bent inward and wired by their cut ends to make the top and complete the cage. A fencing tool and 8-inch lineman's pliers are suitable tools. In use, four 18-inch stakes of 1/2 inch reinforcing iron are driven diagonally inward over the bottom wire so that the cage is held taut and close to the ground. Small mesh wire one foot high around the bottom of the cage will exclude rabbits.



RANGELAND MONITORING - UTILIZATION STUDIES

CAGE TYPE 4

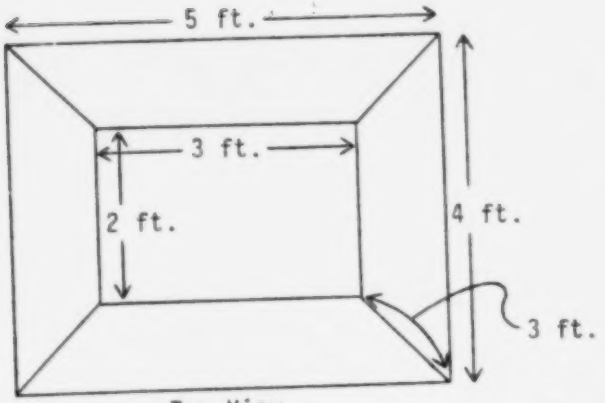
These cages are 4 feet square. They are constructed of No. 9 galvanized wire. Every intersection is electronically welded. Cages are held in place with four pointed steel stakes; one on each side. These cages are easily transported from place to place and fold completely flat.



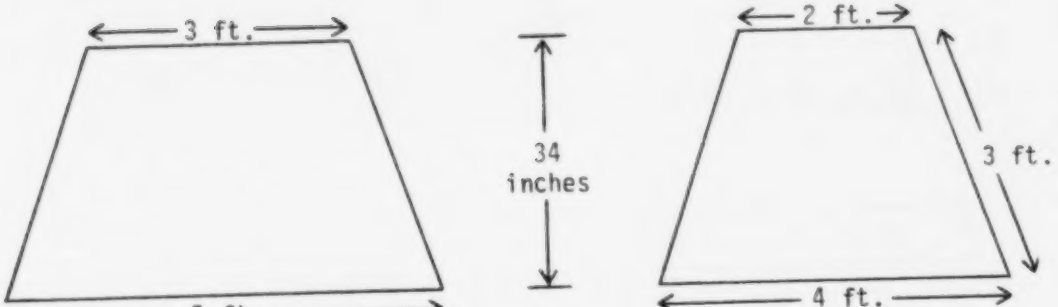
RANGELAND MONITORING - UTILIZATION STUDIES

CAGE TYPE 5

These cages are 4 feet by 5 feet in size. They are constructed with 40 feet of 1/2 inch iron rod and 20 feet of 39 inch galvanized mesh wire. The size of the mesh is discretionary. The joints of the rod frame are welded and the wire is tied to the frame. The cages are held in place with four stakes, at least one foot long, with hooks on the top. These cages are sturdy and are stackable for storage and transporting.



Top View



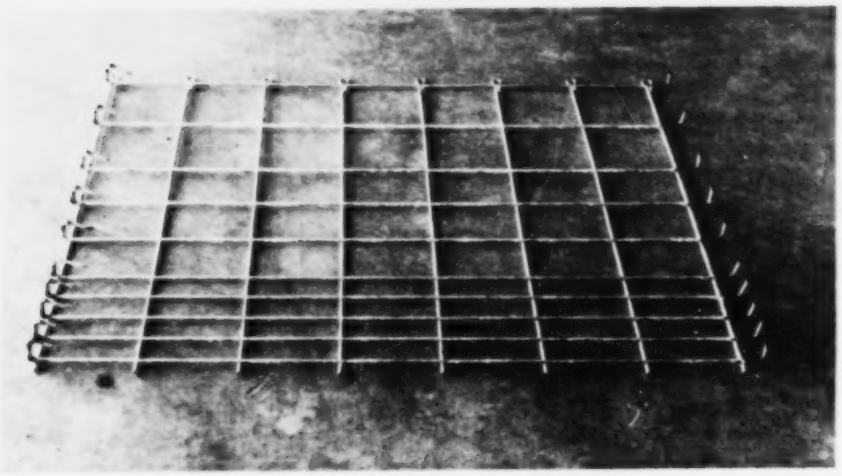
Side View

End View

RANGELAND MONITORING - UTILIZATION STUDIES

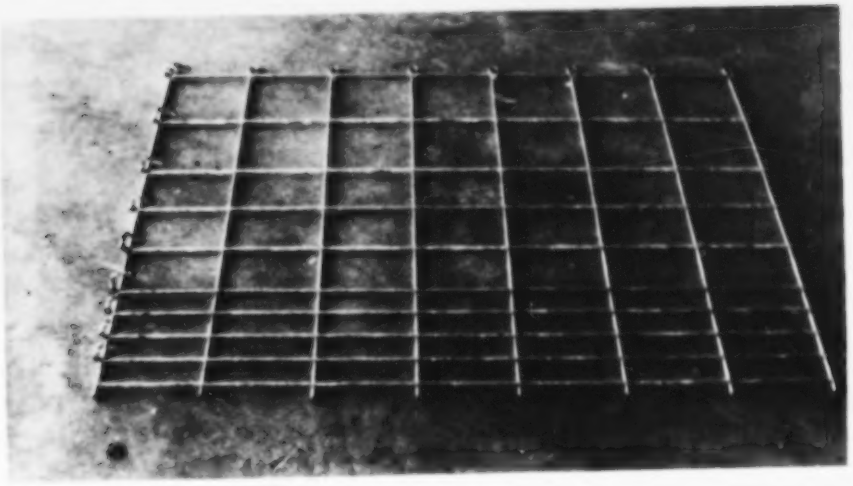
CAGE TYPE 6

These cages are about 4 feet square. They are constructed of prewelded mesh panels made with 1/4 inch rod. The sides of the cages are made by cutting a 32 inch x 16-foot panel (hog panel) into 4 equal parts. The top is one-fourth of a 52 inch x 16-foot panel. An acetylene torch can be used to cut the panels to the desired length. The cut ends are bent into different hooks which hold the cages together. Three types of panels are used for the sides of the cages and one for the top. This type cage can be assembled in less than 5 minutes. The corners all lock together and do not have to be wired. Steel posts should be put on two sides of a cage to prevent livestock from pushing it around. Construction is strong enough to withstand cattle rubbing.

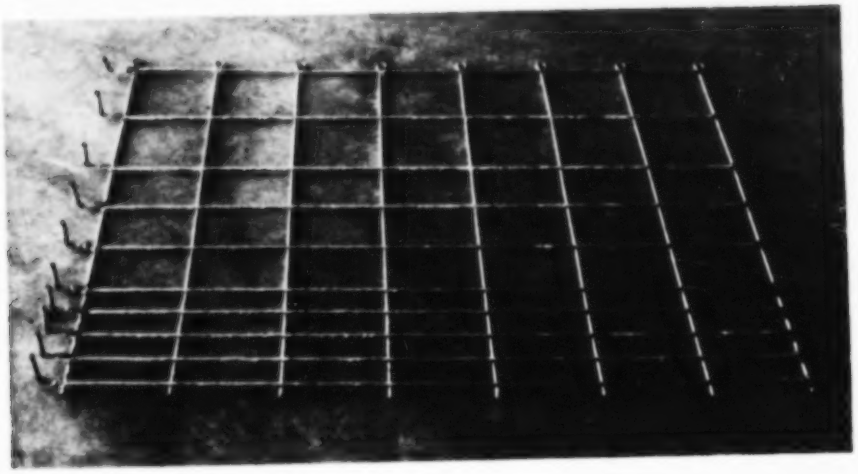


Picture 1 - Panel type 1 (32 inches x about 4 feet). One of these panels is needed for each cage. Note the hook design on both ends of this panel (corner hooks on the left and closing hooks on the right).

RANGELAND MONITORING - UTILIZATION STUDIES

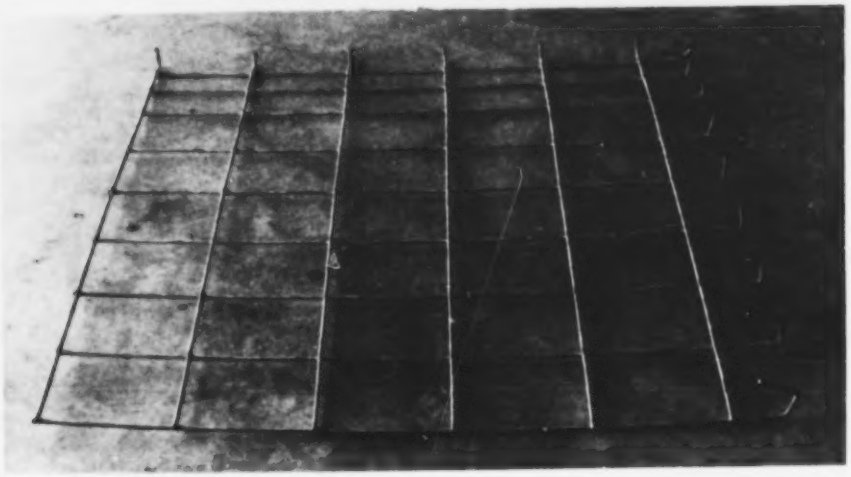


Picture 2 - Panel type 2 (32 inches x about 4 feet).
Two of these panels are needed for each cage. Note the hook design (corner hooks) on the left end of the panel.

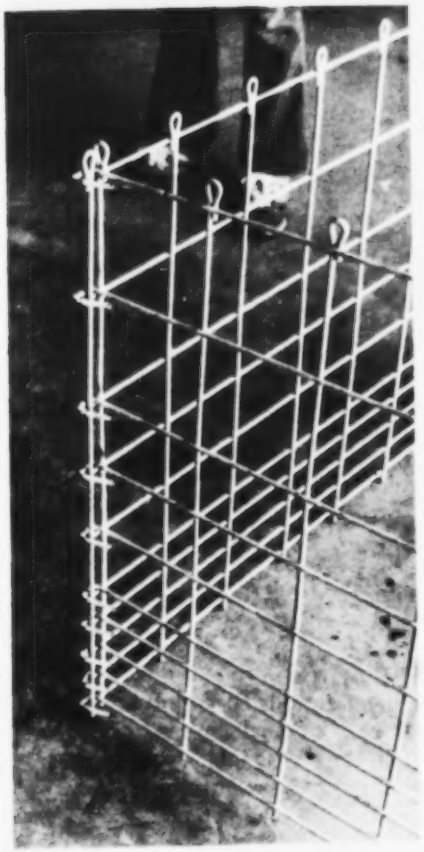


Picture 3 - Panel type 3 (32 inches x about 4 feet).
This is the closing panel. One of these panels is needed for each cage. Note the hook design (closing hooks) on the left end of this panel. The right angle hooks on this panel and those shown on the panel in picture 1 overlap to form a channel for a rebar rod to be thrust through to close the cage as shown in picture 7.

RANGELAND MONITORING - UTILIZATION STUDIES

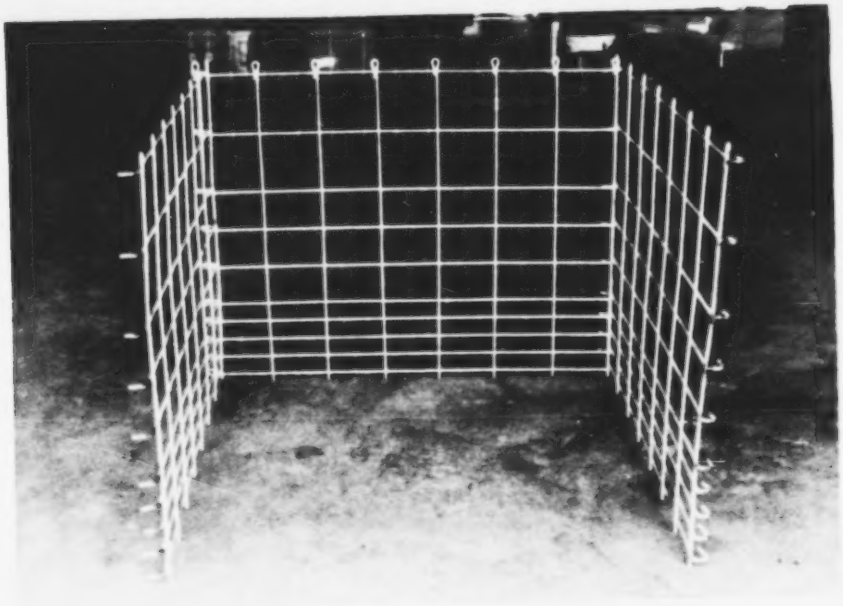


Picture 4 - Top panel (about 4 feet square). One of these panels is needed for each cage. Note the hook design along two sides of this panel.

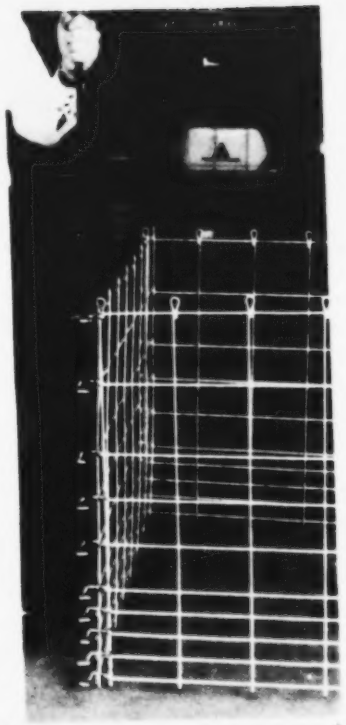


Picture 5 - Shows how two panels are locked together using the corner hooks. Three corners of the cage will look like this. Note that the hooks are on the outside of the cage.

RANGELAND MONITORING - UTILIZATION STUDIES

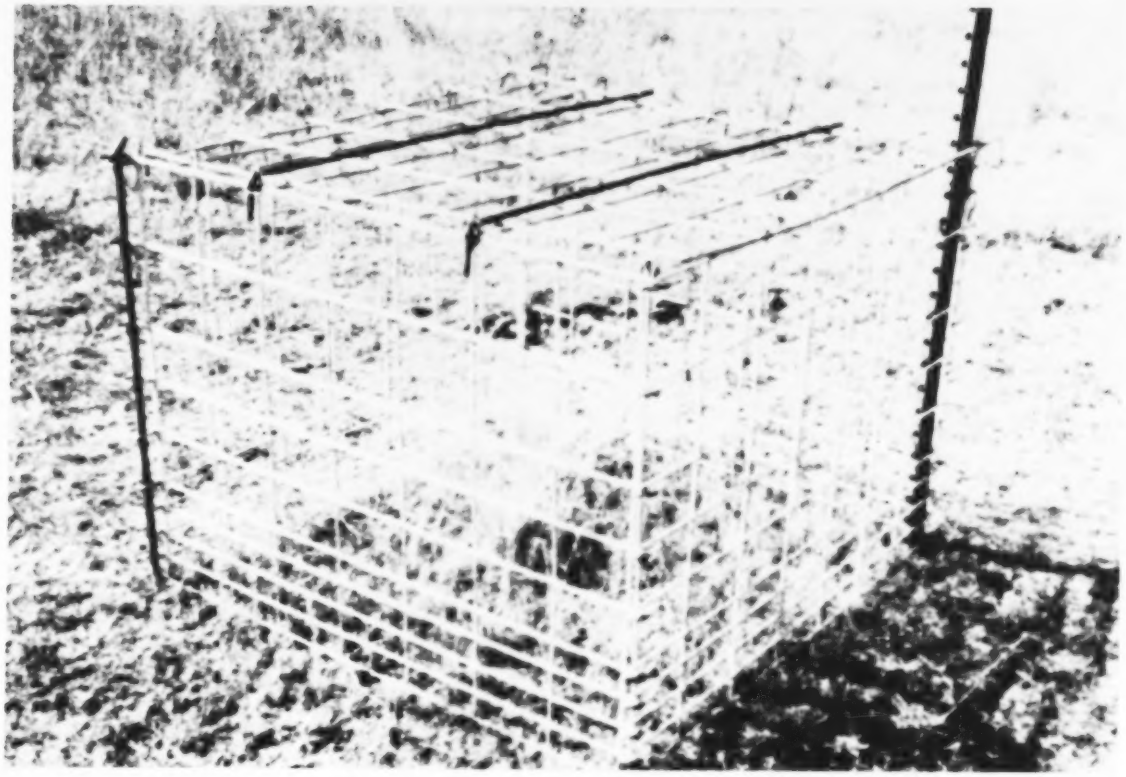


Picture 6 - Shows three panels (panel type 1 on the left and panel type 2 in the center and on the right) locked together. The cage is ready to have the closing panel (panel type 3) put in place.



Picture 7 - Shows how the closing panel (panel type 3) is locked to panel type 1 with a rebar rod being thrust through the closing hooks. The rod can be long enough to extend into the ground if desired.

RANGELAND MONITORING - UTILIZATION STUDIES



Picture 8 - Completely assembled cage. The top panel is hooked on one side of the cage, laid across the cage, and held in place with two 1/4 inch locking rods pushed through loops along the top of side panels of the cage.

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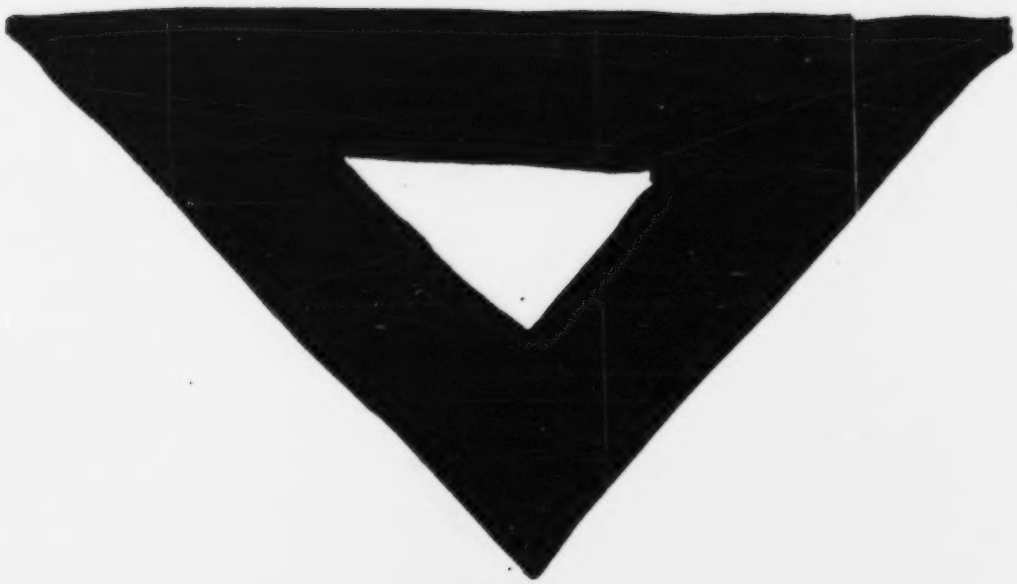
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